Journal of Pharmacognosy and Phytochemistry
Available online at www.phytojournal.com

**E-ISSN:** 2278-4136
**P-ISSN:** 2349-8234
JPP 2019; 8(6): 1426-1431
Received: 04-09-2019
Accepted: 06-10-2019

**Ramesh Malakari Padasalagi**
Department of Agronomy, College of Agriculture, University of Agricultural Sciences, Bangalore, Karnataka, India

**Lalitha BS**
Department of Agronomy, College of Agriculture, University of Agricultural Sciences, Bangalore, Karnataka, India

**Jayadeva HM**
Department of Agronomy, College of Agriculture, University of Agricultural Sciences, Bangalore, Karnataka, India

**Gurunath Raddy**
Department of Agronomy, College of Agriculture, University of Agricultural Sciences, Bangalore, Karnataka, India

**Corresponding Author:**
**Ramesh Malakari Padasalagi**
Department of Agronomy, College of Agriculture, University of Agricultural Sciences, Bangalore, Karnataka, India

# Effect of sulphur and boron on growth and yield of sesame (*Sesamum indicum* L.)

**Ramesh Malakari Padasalagi, Lalitha BS, Jayadeva HM and Gurunath Raddy**

**Abstract**
A field experiment was conducted at Zonal Agricultural Research Station, UAS, GKVK, Bengaluru during kharif 2017 to study the effect of sulphur and boron on growth, yield and quality of sesame (*Sesamum indicum* L.). The experiment was laid out in factorial RCBD design with 12 treatments replicated thrice. Application of 30 kg sulphur with 5 kg borax per hectare recorded significantly higher seed yield of 470.00 kg ha-$^{1}$ and which is on par with application of 40 kg sulphur with 5 kg borax per ha (455.13 kg ha-$^{1}$) and 40 kg sulphur with 2.5 kg borax per ha recorded seed yield of 461.56 kg ha-$^{1}$. Significantly lowest seed yield (273.33 kg ha$^{-1}$) was recorded with no sulphur and borax application. The increased seed yield was mainly due to enhanced growth parameters like plant height (119.20 cm), leaf area per plant (867.00 cm2), total dry matter per plant (25.07 g) at harvest and yield attributes like number of capsules per plant (81.67), length of capsules (4.11 cm) and seeds per locule (41.30).

**Keywords:** Sulphur, boron, growth and yield of sesamum

## Introduction
Sesame (*Sesamum indicum* L.) is one of the oldest oil seed crops grown in the world. It contains 46-64 per cent of oil and 15-16 per cent of protein. Sesame is called as Queen of Oilseeds due to rich source of poly unsaturated stable fatty acids which gives resistance to rancidity. Because of pronounced antioxidant activity of seed oil, it offers higher shelf life and is known as seeds of immortality.
In India, sesame is grown over an area of 18.50 lakh ha and the production of 8.30 lakh tonnes with productivity of 474 kg per ha. In Karnataka, it is grown over an area of 0.45 lakh ha with 0.23 lakh tonnes of production and productivity of 480 kg per ha (Anonymous, 2015) [1]. The lower productivity of sesame is mainly due to cultivation in marginal land and rainfed situation with low input management practices. Yield is the result of various physiological processes occurring in plants and these can be changed by management practices in a given environment. Among the management practices, nutrient management is the most important factor in determining the yield of sesame.
Sulphur requirement is equal to that of phosphorus for oilseed crops as it is directly involved in the synthesis of oil apart from growth and development of the crop. In sesame, sulphur requirement is more since it is required for the synthesis of amino acids like methionine (21%), cysteine (26%) and cystine (27%) which are essential constituents of protein. Approximately, 90 per cent of plant sulphur is present in these amino acids. Sulphur is also required for the synthesis of metabolites like coenzyme A, biotin, thiamin or vitamin $B_1$ & glutathione and also involved in the synthesis of chlorophyll, glucosides and glucosinolates. Sulphur also plays an important role in the plant metabolism, indispensable for the synthesis of essential oils and chlorophyll formation, required for development of cells. It also gives cold resistance and drought hardiness for oilseed crops (Patel and Shelke, 1995) [8].
Boron is one of the essential micronutrient required for normal growth of most of the crops. Its deficiency causes great losses in crop production both quantitatively and qualitatively, which is associated with the pollen producing capacity of anther, viability of pollen tubes, pollen tube germination and growth of pollen tubes. Reduction in supply of boron impairs the quality of oil (Soleimani, 2006) [12]. In this background a study was undertaken to study the effect of sulphur and boron on growth, yield and quality of sesame.

## Material and Methods
The field experiment was conducted during *kharif* 2017 to study the Effect of sulphur and boron on yield and quality of sesame (*Sesamum indicum* L.). Field experiment was conducted in Plot No. 2 of E block, at Zonal Agricultural Research Station, Gandhi Krishi Vignana

Kendra, University of Agricultural Sciences, Bengaluru. The farm is situated at 13º 05' N latitude and 77º 34' E longitude with an altitude of 924 m above the mean sea level which comes under Eastern Dry Zone (ACZ-V) of Karnataka. The soil of the experimental site was red sandy loam texture. Composite soil sample to a depth of 0-30 cm was collected from the experimental site before sowing and analyzed for physico-chemical properties.
The experimental data collected on various growth and yield parameters of sesame plant was subjected to Fishers method of 'Analysis of Variance' (Anova). Wherever the F-test was found significant for comparison among treatment means, an appropriate value of critical difference (CD) was worked out. Otherwise the abbreviation NS was indicated against the CD values. The entire data was analyzed and the results are presented and discussed at a probability level of 5 per cent for field experiment and 1 per cent for laboratory experiment.

## Results and Discussion

### Plant Height

Significantly higher plant height was recorded with application of sulphur at 40 kg per ha at harvest (113.64 cm) and it was on par with 30 kg sulphur per ha (113.12 cm height at harvest). Significantly lower plant height was recorded with no sulphur application (101.39 cm at harvest). Application of 5 kg borax per ha recorded significantly higher plant height at harvest (111.44 cm) and it was on par with 2.5 kg per ha (109.54 cm at harvest respectively). Significantly lowest plant height of 103.62 cm was recorded with no borax application at harvest. Increased plant height might be due to more cell division, carbohydrates metabolism and increased growth of meristematic tissues. Sulphur application increases the plant height augmented to synergism of sulphur with nitrogen and other macro and micro nutrients which might have increased the plant height of sesame (Table 1).

### Number of leaves

Significantly more number of leaves per plant (34.06) was reported with the application of 40 kg sulphur per ha at harvest and it was on par with the application of 30 kg sulphur per ha that recorded 33.48 leaves per plant at harvest. Significantly lowest number of leaves (26.82) were recorded with no sulphur application at harvest. Application of 5 kg borax per ha recorded significantly more number of leaves per plant at harvest (32.59) which was found on par with the application of 2.5 kg borax per ha recording 31.92 leaves per plant at harvest. Significantly lowest numbers of leaves (29.36) were recorded with no borax application at harvest. Increased number of leaves per plant is due to more number of nodes, internode elongation and more branches produced on stem. Similar findings were reported by Kalaiyarasan *et al.*, 2002 [4].

### Leaf area

Significantly higher leaf area per plant was reported with the application of 40 kg sulphur per ha (817.89 $cm^2$) and this was on par with 30 kg sulphur per ha which recorded 795.44 $cm^2$ leaf area per plant at harvest. Application of 5 kg borax per ha recorded significantly more leaf area per plant (692.46 $cm^2$) at harvest which was on par with the application of 2.5 kg borax per ha that recorded 664.67 $cm^2$ leaf area per plant at harvest. Application of 30 kg sulphur with 5 kg borax per ha recorded significantly more leaf area (867 $cm^2$) per plant at harvest and it was found on par with application of 40 kg sulphur with 5 kg borax per ha that recorded leaf area of 841 $cm^2$. 40 kg sulphur with 2.5 kg borax per ha and 30 kg sulphur with 2.5 kg borax per ha recorded leaf area of 827 and 821.55 $cm^2$ at harvest, respectively. Increased plant height and more number of leaves led to more leaf area and dry matter due to effective photosynthates production and availability for better growth of leaves which increased the size of the leaves through application of sulphur at 40 kg per ha. These results were in conformity with the findings of Shinde *et al.* (2011) [10] and Kathiresan *et al.* (1999) [6] in sesame and soybean, respectively (Table 1).

### Dry matter production

Results tabulated in Table 2 indicated significantly higher total dry matter accumulation with the application of 40 kg sulphur per ha at harvest (23.74 g $plant^{-1}$) and it was on par with 30 kg sulphur per ha (22.74 g $plant^{-1}$) at harvest. Application of 5 kg borax per ha recorded significantly higher total dry matter accumulation at harvest (22.20 g $plant^{-1}$) which was on par with the application of 2.5 kg borax per ha (21.1 g $plant^{-1}$ at harvest). Application of 30 kg sulphur with 5 kg borax per ha recorded significantly higher total dry matter accumulation at harvest (25.07 g $plant^{-1}$).

### Leaf area index

A cursory look at Table 2 reveals that application of 40 kg sulphur per ha reported significantly higher leaf area index of 1.82 at the time of harvest and it was on par with 30 kg sulphur per ha (1.77) at harvest. Significantly lower leaf area index of 0.96 at harvest was observed with no sulphur application. Borax application at 5 kg per ha recorded significantly higher leaf area index (1.54 at harvest) and which found on par with 2.5 kg borax per ha (1.48) LAI at harvest. Significantly lowest leaf area index (1.35) at harvest reported with no borax application. Application of 30 kg sulphur with 5 kg borax per ha recorded significantly higher leaf area index at harvest (1.93) and it was found on par with application of 40 kg sulphur with 5 kg borax per ha that recorded leaf area index of 1.87. 40 kg sulphur with 2.5 kg borax per ha and 30 kg sulphur with 2.5 kg borax per ha recorded leaf area index of 1.84 and 1.82 at harvest, respectively. Significantly lowest leaf area index (0.93) was observed with no sulphur and borax application at harvest.
Application of sulphur at 30 kg with borax 5 kg per ha together increased all growth parameters like plant height, number of leaves, leaf area and dry matter. This might be due their synergetic interaction towards the enrichment of soil nitrogen, phosphorous and potassium. These macronutrients resulted in better biological activity that promoted increased vegetative growth of crop. These findings are in accordance with findings of Jeena Mathew and Sumam George (2016) [3].

### Number of capsules

Sulphur application at 40 kg per ha registered significantly more number of capsules per plant (78.11) and was on par with the application of 30 kg sulphur per ha (74.94). Significantly lowest number of capsules per plant (59) was recorded with no sulphur application. Application of 5 kg borax per ha recorded significantly more number of capsules per plant (73.92) and was on par with application of 2.5 kg borax per ha that recorded 71.83 capsules per plant. Significantly lowest (66.46) number of capsules per plant was recorded with no borax application. Among interactions, application of 30 kg sulphur with 5 kg borax per ha recorded significantly more number of capsules per plant (81.67) and it found on par with application of 40 kg sulphur with 5 kg borax per ha recording 79 capsules per plant. 40 kg sulphur with 2.5 kg borax per ha and 30 kg sulphur with 2.5 kg borax per ha recorded 77.67 and 76.67 number of capsules per plant respectively. Significantly lowest (54.67) number of capsules per plant was recorded with no sulphur and borax application. This was augmented that application of sulphur increases the yield by increasing the sulphur from source (assimilate) to sink (seed) which would have increased the number of capsules per plant. More number of flower production after boron application is mainly due to production of auxins which helped retention of flowers and reduced the flower drop. However, duration of flowering and start of flowering in sesame were not influenced by boron. This ultimately recorded more number of capsules per plant (Table 2).

**Length of capsule**

Sulphur application at 40 kg per ha reported significantly higher length of capsules (3.47 cm) and was on par with 30 kg sulphur per ha (3.46 cm). Significantly lowest length of capsule (2.99 cm) was recorded with no sulphur application. Application of 5 kg borax per ha registered significantly higher length of capsules (3.47 cm) and it found on par with the application of 2.5 kg borax per ha (3.27 cm). Significantly lowest length of capsule (3.15 cm) was recorded with no borax application. Among interactions, application of 30 kg sulphur with 5 kg borax per ha recorded significantly higher length of capsules (4.11 cm) and was on par with application of 40 kg sulphur with 5 kg borax per ha which recorded the capsule length of 3.71 cm. 40 kg sulphur with 2.5 kg borax per ha and 30 kg sulphur with 2.5 kg borax per ha recorded the capsule length of 3.65 cm and 3.61 cm respectively. Significantly lowest length of capsule (2.84 cm) was recorded with no sulphur and borax application. This is mainly due to effective translocation of photosynthates from source to sink resulting in higher length of capsules. These findings are in line with findings of Smith *et al.,* 1997 [11].

**Number of seeds per locule**

Results depicted in Table 3 indicates that application of 40 kg sulphur per ha recorded significantly more seeds per locule (38.33) and it was on par with 30 kg sulphur per ha (36.84). Significantly lowest (33.08) was recorded with no sulphur application. Application of 5 kg borax per ha registered significantly more seeds per locule (37.20) and which found on par with 2.5 kg borax per ha (36.15). Significantly lowest seed per locule (35.22) was recorded with no borax application. Among interactions, application of 30 kg sulphur with 5 kg borax per ha recorded significantly more seeds per locule (41.30) which was on par with application of 40 kg sulphur with 5 kg borax per ha, 40 kg sulphur with 2.5 kg borax per ha and 30 kg sulphur with 2.5 kg borax per ha (39.81, 39.12 and 38.57, respectively). Significantly lowest (32.18) was recorded with no sulphur and borax application. This may be due to effective translocation of photosynthates from source to sink that resulted in more length of capsules with more number of seeds per locule. These findings are in line with findings of Smith *et al.,* 1997 [11].

**Test weight**

There was no significant difference found with respect to test weight among different levels of sulphur, borax and their interactions.

**Seed yield**

Data presented in Table 4 revealed that application of 40 kg sulphur per ha recorded significantly higher seed yield (424.67 kg ha$^{-1}$) and was on par with 30 kg per ha sulphur application (423.90 kg ha$^{-1}$). Significantly lowest seed yield (273.33 kg ha$^{-1}$) was recorded with no sulphur and boron application. Significantly higher seed yield (393.25 kg ha$^{-1}$) recorded with application of 5 kg borax per ha and was on par with the application of 2.5 kg borax per ha that recorded the yield of 381.29 kg ha$^{-1}$. Significantly lowest seed yield of 347.12 kg ha$^{-1}$ was recorded with no borax application. Among interaction, application of 30 kg sulphur with 5 kg borax per ha recorded significantly higher seed yield of 470 kg ha$^{-1}$. Application of 40 kg sulphur with 5 kg borax per ha recorded seed yield of 455.13 kg ha$^{-1}$, while application of 40 kg sulphur with 2.5 kg borax per ha recorded seed yield of 461.56 kg ha$^{-1}$. Significantly lowest seed yield of 273.33 kg per ha was recorded with no sulphur and borax application.

Application of sulphur at 30 kg per ha helped in floral primordial initiation that resulted in higher number of capsules per plant and boron application helped in better pollen tube elongation and improved seed setting. Increased photosynthetic rate by sulphur (Kalaiyarasan *et al.* 2002) [4] and improved health of pollen by 5 kg per ha borax, resulted in proper growth of pollen tube after fertilization and led to increased fertilization which ultimately resulted in increased number of capsules per plant and length of capsule which ultimately increased number of seeds per locule because of better source to sink relation. These findings are in accordance with findings of Prakash *et al.* (2013) [9]. Synergistic action of both sulphur and boron with macronutrients like nitrogen, phosphorous and potassium might have increased the length of capsule with effective translocation of photosynthates with enhanced seed set because of increased pollination. This is in conformity with findings of Mahajan *et al.* (2013) [7]. Seed yield was mainly determined by yield attributing parameters *viz.*, number of capsules per plant, test weight, seed weight per plant and dry matter accumulation. These parameters were found significant at 30 kg sulphur per ha applied through elemental sulphur with 5 kg borax per ha. The results are similar with the findings of Gokhale *et al.* (2005) and Kalaiyarasan *et al.* (2007) [2, 5].

**Conclusion**

Significantly higher seed yield was recorded with application of 30 kg sulphur with 5 kg borax per ha and which was on par with 40 sulphur and 5 kg borax and 40 kg sulphur with 2.5 kg borax per ha. The increased seed yield was mainly attributed to the increased growth parameters like plant height, leaf area per plant and total dry matter at harvest and also increased yield characters like number of capsules per plan, length of capsule and number of seeds per lacule.

**Table 1:** Plant height, number of leaves per plant and leaf area per plant of sesame as influenced by application of different levels of sulphur and boron

| Treatments | Plant height at harvest (cm) | Number of leaves per plant at harvest | Leaf area per plant at harvest ($cm^2$) |
|---|---|---|---|
| **Factor A : Sulphur levels (S)** | | | |
| $S_0$: 0 kg $ha^{-1}$ | 101.39 | 26.82 | 431.12 |
| $S_1$: 20 kg $ha^{-1}$ | 104.64 | 30.80 | 573.37 |
| $S_2$: 30 kg $ha^{-1}$ | 113.12 | 33.48 | 795.44 |
| $S_3$: 40 kg $ha^{-1}$ | 113.64 | 34.06 | 817.89 |
| S.Em± | 1.26 | 0.38 | 15.13 |
| CD (P=0.05) | 3.71 | 1.12 | 45.46 |
| **Factor B : Boron levels (B)** | | | |
| $B_0$: 0 kg $ha^{-1}$ | 103.62 | 29.36 | 606.37 |
| $B_1$: 2.5 kg $ha^{-1}$ | 109.54 | 31.92 | 664.67 |
| $B_2$: 5.0 kg $ha^{-1}$ | 111.44 | 32.59 | 692.46 |
| S.Em± | 1.09 | 0.33 | 13.00 |
| CD (P=0.05) | 3.21 | 0.97 | 39.00 |
| **Interaction (A x B)** | | | |
| $S_0B_0$ | 100.33 | 25.20 | 416.43 |
| $S_0B_1$ | 100.40 | 28.33 | 418.12 |
| $S_0B_2$ | 103.43 | 26.93 | 458.89 |
| $S_1B_0$ | 104.80 | 29.57 | 548.37 |
| $S_1B_1$ | 103.67 | 30.17 | 568.60 |
| $S_1B_2$ | 105.47 | 32.67 | 602.44 |
| $S_2B_0$ | 103.33 | 30.00 | 674.37 |
| $S_2B_1$ | 116.83 | 34.50 | 821.55 |
| $S_2B_2$ | 119.20 | 35.93 | 867.48 |
| $S_3B_0$ | 106.00 | 32.67 | 785.55 |
| $S_3B_1$ | 117.27 | 34.67 | 827.60 |
| $S_3B_2$ | 117.67 | 34.83 | 841.43 |
| S.Em± | 2.19 | 0.66 | 26.89 |
| CD (P=0.05) | 6.42 | 1.94 | 78.46 |

**Table 2:** Total dry matter per plant and leaf area index of sesame as influenced by application of different levels of sulphur and boron

| Treatments | Total dry matter per plant (g $plant^{-1}$) at harvest | Leaf area index at harvest |
|---|---|---|
| **Factor A : Sulphur levels (S)** | | |
| $S_0$: 0 kg $ha^{-1}$ | 17.21 | 0.96 |
| $S_1$: 20 kg $ha^{-1}$ | 19.47 | 1.27 |
| $S_2$: 30 kg $ha^{-1}$ | 22.74 | 1.77 |
| $S_3$: 40 kg $ha^{-1}$ | 23.74 | 1.82 |
| S.Em± | 0.47 | 0.03 |
| CD (P=0.05) | 1.39 | 0.10 |
| **Factor B : Boron levels (B)** | | |
| $B_0$: 0 kg $ha^{-1}$ | 19.17 | 1.35 |
| $B_1$: 2.5 kg $ha^{-1}$ | 21.00 | 1.48 |
| $B_2$: 5.0 kg $ha^{-1}$ | 22.20 | 1.54 |
| S.Em± | 0.41 | 0.03 |
| CD (P=0.05) | 1.21 | 0.09 |
| **Interaction (A x B)** | | |
| $S_0B_0$ | 16.50 | 0.93 |
| $S_0B_1$ | 17.28 | 0.93 |
| $S_0B_2$ | 17.83 | 1.02 |
| $S_1B_0$ | 18.00 | 1.22 |
| $S_1B_1$ | 18.73 | 1.26 |
| $S_1B_2$ | 21.67 | 1.34 |
| $S_2B_0$ | 19.17 | 1.50 |
| $S_2B_1$ | 23.98 | 1.82 |
| $S_2B_2$ | 25.07 | 1.93 |
| $S_3B_0$ | 22.00 | 1.74 |
| $S_3B_1$ | 24.00 | 1.84 |
| $S_3B_2$ | 24.22 | 1.87 |
| S.Em± | 0.82 | 0.06 |
| CD (P=0.05) | 2.41 | 0.18 |

**Table 3:** Number of capsules per plant, length of capsule and seeds per locule of sesame as influenced by application of different levels of sulphur and boron

| Treatments | Number of capsule per plant | Length of capsule (cm) | Seeds per locule |
|---|---|---|---|
| **Factor A : Sulphur levels (S)** | | | |
| $S_0$: 0 kg $ha^{-1}$ | 59.00 | 2.99 | 33.08 |
| $S_1$: 20 kg $ha^{-1}$ | 69.56 | 3.26 | 36.50 |
| $S_2$: 30 kg $ha^{-1}$ | 74.94 | 3.46 | 36.84 |
| $S_3$: 40 kg $ha^{-1}$ | 78.11 | 3.47 | 38.33 |
| S.Em± | 1.10 | 0.10 | 0.58 |
| CD (P=0.05) | 3.22 | 0.29 | 1.70 |
| **Factor B : Boron levels (B)** | | | |
| $B_0$: 0 kg $ha^{-1}$ | 66.46 | 3.15 | 35.22 |
| $B_1$: 2.5 kg $ha^{-1}$ | 71.83 | 3.27 | 36.15 |
| $B_2$: 5.0 kg $ha^{-1}$ | 73.92 | 3.47 | 37.20 |
| S.Em± | 0.95 | 0.09 | 0.50 |
| CD (P=0.05) | 2.792928 | 0.25 | 1.47 |
| **Interaction (A x B)** | | | |
| $S_0B_0$ | 54.67 | 2.84 | 32.18 |
| $S_0B_1$ | 59.33 | 2.92 | 33.77 |
| $S_0B_2$ | 63.00 | 3.21 | 33.30 |
| $S_1B_0$ | 67.00 | 3.24 | 35.00 |
| $S_1B_1$ | 69.67 | 3.24 | 36.47 |
| $S_1B_2$ | 72.00 | 3.29 | 38.03 |
| $S_2B_0$ | 66.50 | 2.99 | 35.70 |
| $S_2B_1$ | 76.67 | 3.61 | 38.57 |
| $S_2B_2$ | 81.67 | 4.11 | 41.30 |
| $S_3B_0$ | 74.67 | 3.51 | 38.00 |
| $S_3B_1$ | 77.67 | 3.65 | 39.12 |
| $S_3B_2$ | 79.00 | 3.71 | 39.81 |
| S.Em± | 1.90 | 0.17 | 1.00 |
| CD (P=0.05) | 5.58 | 0.51 | 2.94 |

**Table 4:** Seed yield and test weight of sesame seed as influenced by application of different levels of sulphur and boron

| Treatments | Seed yield (kg $ha^{-1}$) | Test wt (g) |
|---|---|---|
| **Factor A : Sulphur levels (S)** | | |
| $S_0$: 0 kg $ha^{-1}$ | 290.53 | 3.05 |
| $S_1$: 20 kg $ha^{-1}$ | 356.12 | 3.05 |
| $S_2$: 30 kg $ha^{-1}$ | 423.90 | 3.03 |
| $S_3$: 40 kg $ha^{-1}$ | 424.67 | 3.05 |
| S.Em± | 7 | 0.10 |
| CD (P=0.05) | 22 | NS |
| **Factor B : Boron levels (B)** | | |
| $B_0$: 0 kg $ha^{-1}$ | 347.12 | 3.05 |
| $B_1$: 2.5 kg $ha^{-1}$ | 381.29 | 3.04 |
| $B_2$: 5.0 kg $ha^{-1}$ | 393.25 | 3.05 |
| S.Em± | 6.51 | 0.09 |
| CD (P=0.05) | 19.08 | NS |
| **Interaction (A x B)** | | |
| $S_0B_0$ | 273.33 | 3.11 |
| $S_0B_1$ | 302.12 | 3.04 |
| $S_0B_2$ | 296.32 | 3.02 |
| $S_1B_0$ | 335.42 | 3.06 |
| $S_1B_1$ | 381.34 | 3.02 |
| $S_1B_2$ | 383.12 | 3.07 |
| $S_2B_0$ | 350.45 | 3.04 |
| $S_2B_1$ | 445.23 | 3.06 |
| $S_2B_2$ | 470.00 | 3.00 |
| $S_3B_0$ | 416.15 | 3.02 |
| $S_3B_1$ | 455.13 | 3.04 |
| $S_3B_2$ | 461.56 | 3.09 |
| S.Em± | 13.01 | 0.17 |
| CD (P=0.05) | 38.16 | NS |

## References

1. Anonymous. Directorate of Economics and Statistics, Department of Agriculture and Co-operation, Ministry of Agriculture, Govt. of India, 2015.
2. Gokhale DN, Kanade AG, Karanjikar PN, Patil VD. Effect of sources and levels of sulphur on seed yield, quality and sulphur uptake by soybean (*Glycine max* L.). J Oil seeds Res. 2005; 22(1):192-193.

3. Jeena M, Sumam G. Sustaining the productivity of sesame (*Sesamum indicum* L.) grown in Onattukara andy soil through the application of sulphur and boron. Asian J Soil Sci. 2016; 11(2):318-323.
4. Kalaiyarasan C, Vaiyapuri V, Sekharan MVSR. Effect of sulphur sources and levels on the growth and yield of groundnut in red lateritic soil. Ann. Agric. Res. 2002; 23(4):618-621.
5. Kalaiyarasan C, Vaiyapuri V, Sriramachandrasekharan, MV. Effect of sulphur sources and levels on the nutrient uptake, crop quality and SUE in groundnut. J Interacademicia. 2007; 11(1):55-58.
6. Kathiresan. Effect of urea enriched FYM on growth and yield of soybean (*Glycine max* L. Merr). Indian J. Plant Physiol. 1999; 5(2):142-144.
7. Mahajan R, Bharathi K, Sekhar SH, Ranganath G. Effect of integrated nutrient management on seed yield and economics of sesame. J Oilseeds Res. 2013; 27(5):79-81.
8. Patel JR, Shelke VB. Effect of farmyard manure, phosphorus and sulphur on growth, yield and quality of Indian mustard. Ind. J Agron. 1995; 43(5):713-717.
9. Prakash M, Saravanan K, Sunil Kumar B, Jagadeesan S, Ganesan J. Effect of plant growth regulators and micronutrients on yield attributes of sesame. Sesame Safflower Newslett, 2013, 18p.
10. Shinde SD, Raskar BS, Tamboli BD. Effect of spacing and sulphur levels on productivity of sesame (*Sesamum indicum* L.) under summer condition. J Maharastra Agric. Univ. 2011; 36(1):28-31.
11. Smith R, Sinha RB, Singh AP, Bhogal NS. Effect of boron and FYM alone and in combination on nutrition of crops in maize-lentil cropping system. Fert. News. 1997; 44(11):49-52.
12. Soleimani S. Effect of boron levels on potato and sesame crop sequence. Ann. Hort. 2006; 6(1):60-64.