

Original Research Article

Impact of different levels of Sulphur and foliar application of boron on zaid sunflower (*Helianthus annus L.*)

Abstract

The study was conducted during the *Zaid* season of 2022 on Sunflower crop at the CRF in the department of Agronomy. The experimental design consisted of 10 treatments, including a control, with 3 levels of Sulphur (40, 45, and 50 kg/ha) and 3 levels of Boron (200 ppm at 30 and 45 days and 100 ppm at 30 and 45 DAS). The experiment was arranged in a Randomized Block Design with three replications. The application of Sulphur at 50 kg/ha + Boron 100 ppm at 30 and 45 DAS showed the highest stem girth, plant dry weight and yield attributes, including test weight, seed yield and stover yield.

Key words: *Sulphur, Boron, Growth, Yield, Zaid.*

INTRODUCTION

The sunflower (*Helianthus annuus* L.) is a member of the Compositae family that originated in Mexico and Peru and was introduced to India in the 16th century. It is an important oilseed crop with seeds containing approximately 35-40% oil, with some varieties containing up to 50%. Sunflower oil is a rich source of linoleic acid, comprising 64% of its composition, which aids in the removal of cholesterol deposits in the coronary arteries, making it beneficial for heart patients. The crop requires high levels of potassium in addition to nitrogen to improve grain yield and quality. Sunflower has played a significant role in achieving self-sufficiency in edible oil in India and is a crucial element of the "Yellow Revolution" (Rai, 2002). Sulphur is essential in increasing the percentage of oil in sunflower seeds and plays an important role in its chemical composition (Demurin et al., 2001). Sunflower requires the same amount of Sulphur or more than phosphorus for high yield and product quality (Jamal et al. 2010). Bhagat et al. (2005) demonstrated the importance of Sulphur in the biosynthesis of oil in sunflowers and how the application of Sulphur increases the oil content in sunflower seeds. Sulphur is also necessary for the synthesis of certain vitamins, including B vitamins, biotin, and thiamine, as well as the metabolism of carbohydrates, proteins, and oil formation of flavored compounds. Boron plays a crucial role in the synthesis of cell walls, root elongation, glucose metabolism, nucleic acid synthesis, lignification, and tissue differentiation. Sunflower is one of the most sensitive field crops to boron deficiency, and even a slight shift in the margin between sufficiency and deficiency can have a significant impact on productivity. Boron deficiency symptoms typically manifest as stem corkiness, deformed capitulum, poor seed set, and lower seed yield, appearing on the leaves, stems, and reproductive parts. The present investigation aims to consider the importance of these factors in improving sunflower crop yield and quality.

MATERIALS AND METHODS:

The *Zaid* season of 2022 was selected for the experiment, which was designed in a Randomized Block Design with ten treatment combinations and three replications. The different treatments were randomly allocated in each replication. The soil in the experimental field was sandy loam in texture with a slightly alkaline reaction (pH 7.2) and low levels of organic carbon (0.28%), available nitrogen (225 kg/ha) and phosphorus (19.50 kg/ha), but higher levels of potassium (92.00 kg/ha). The ten treatment combinations were as follows: T₁ - Sulphur 40 kg/ha + Boron 200 ppm at 30 DAS, T₂- Sulphur 40 kg/ha + Boron 200 ppm at 45 DAS, T₃ - Sulphur 40 kg/ha + Boron 100 ppm at 30 and 45 DAS, T₄ - Sulphur 45 kg/ha + Boron 200 ppm at 30 DAS, T₅ - Sulphur 45 kg/ha + Boron 200 ppm at 45 DAS T₆ - Sulphur 45 kg/ha + Boron 100 ppm at 30 and 45 DAS, T₇- Sulphur 50 kg/ha + Boron 200 ppm at 45 DAS T₈ - Sulphur 50 kg/ha + Boron 200 ppm at 45 DAS T₉ - Sulphur 50 kg/ha + Boron 100 ppm at 30 and 45 DAS T₁₀ - Control: N:P:K - 60:45:45 (kg/ha). The growth parameters observed at harvest included plant height(cm) , stem girth , plant dry weight, number of seeds per capitulum, test weight, seed yield, stover yield, and harvest index.

RESULTS AND DISCUSSION

A. Growth Attributes:

At 60 DAS, treatment T₈ (Sulphur 50 kg/ha + Boron 200 ppm at 45 DAS) recorded maximum plant height (150.15 cm), treatment T₆ (Sulphur 45 kg/ha + Boron 100 ppm at 30 and 45 DAS) was statistically at par with T₈, with a plant height of (144.18 cm). The increase in plant height may be attributed to the appropriate dose of boron, which plays an important role in various enzymatic and biochemical reactions. Zahoor et al. (2011) reported similar results. The Treatment T₉ (Sulphur 50 kg/ha + Boron 100 ppm at 30 and 45 DAS) recorded the highest Stem girth (2.96 cm), which was significantly greater than all other treatments. However , treatments T₈ (Sulphur 50 kg/ha + Boron 200 ppm at 45 DAS) was found statistically at par with T₉ (Sulphur 50 kg/ha + Boron 100 ppm at 30 and 45 DAS) with Stem girth of (2.74 cm) . Furthermore, treatment T₉ (Sulphur 50 kg/ha + Boron 100 ppm at 30 and 45 DAS recorded the highest dry weight (50.67 g/plant), which was significantly greater than all other treatments. However, treatments T₈ (Sulphur 50 kg/ha + Boron 200 ppm at 45 DAS) and T₆(Sulphur 45 kg/ha + Boron 100 ppm at 30 and 45 DAS) were statistically at par with treatment T₉ (Sulphur 50 kg/ha + Boron 100 ppm at 30 and 45 DAS) with dry weights of (48.33 g/plant) and (47.87 g/plant), respectively.

B. Yield Attributes

The application of Sulphur and Boron at different stages of growth resulted in varied effects on the yield components of the crop. The highest number of seeds per capitulum (367.86) was recorded with the application of treatment T₉, which involved the use of Sulphur at 50 kg/ha and foliar sprays of Boron at 100 ppm at 30 and 45 DAS. Treatment T₈, which involved Sulphur at 50 kg/ha and foliar spray of Boron at 200 ppm at 45 DAS recorded a seed yield of 351.82, which was not significantly different from that of T₉. The highest test weight (40.84 g) was recorded with the use of treatment T₉. However, treatment T₈, which involved Sulphur at 50 kg/ha and foliar sprays of Boron at 200 ppm at 45 DAS was found to be statistically at par with T₉.

The highest seed yield (1.48 t/ha) was recorded with treatment T₉, which involved Sulphur at 50 kg/ha and foliar sprays of Boron at 100 ppm at 30 and 45 DAS. However, treatment T₈, which involved Sulphur at 50 kg/ha and foliar sprays of Boron at 200 ppm at 45 DAS and treatment T₇, which involved Sulphur at 50 kg/ha and foliar sprays of Boron at 200 ppm at 30 DAS, were found to be statistically at par with T₉. The increased yield can be attributed to higher dry matter accumulation and better translocation of photosynthates, which led to an increase in yield components.

Treatment T₉ also recorded the highest stover yield (3.87 t/ha). However, treatment T₈, which involved Sulphur at 50 kg/ha and foliar sprays of Boron at 200 ppm at 45 DAS was found to be statistically at par with T₉. The increase in stover yield can be attributed to the overall improvement in plant organs associated with faster and uniform vegetative growth of the crop with sulphur application.

The highest harvest index (36.07 %) was recorded in treatment T₆, which involved Sulphur at 45 kg/ha and foliar sprays of Boron at 100 ppm at 30 and 45 DAS. Treatment T₁, which involved Sulphur at 40 kg/ha and foliar sprays of Boron at 200 ppm at 30 DAS was found to be statistically similar to T₆.

CONCLUSION

The results of this one-season experiment suggest that the application of 50 kg/ha Sulphur + 100 ppm foliar sprays of Boron at 30 and 45 DAS (Treatment 9) resulted in the highest seed yield and benefit cost ratio.

However, it should be noted that these conclusions are based on data from only one season and further confirmation is needed before making recommendations.

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Table.1 Effect of Sulphur and boron on growth attributes of Sunflower.

| Treatments | Plant height(cm) at 60 DAS | Stem girth (cm) at 60 DAS | Dry Weight(g/plant) at 60 DAS |
|---|-------------------------------|------------------------------|----------------------------------|
| Sulphur 40 Kg/ha + Boron 200 ppm at 30 DAS | 124.5 | 1.93 | 35.67 |
| Sulphur 40 Kg/ha + Boron 200 ppm at 45 DAS | 133.30 | 2.08 | 41.87 |
| Sulphur 40 Kg/ha + Boron 100 ppm at 30 and 45 DAS | 135.37 | 2.29 | 45.05 |
| Sulphur 45 Kg/ha + Boron 200 ppm at 30 DAS | 129.75 | 2.03 | 32.63 |
| Sulphur 45 Kg/ha + Boron 200 ppm at 45 DAS | 121.74 | 2.01 | 35.53 |
| Sulphur 45 Kg/ha + Boron 100 ppm at 30 and 45 DAS | 144.18 | 2.17 | 47.87 |
| Sulphur 50 Kg/ha + Boron 200 ppm at 30 DAS | 136.98 | 2.25 | 46.94 |
| Sulphur 50 Kg/ha + Boron 200 ppm at 45 DAS | 150.15 | 2.74 | 48.33 |
| Sulphur 50 Kg/ha + Boron 100 ppm at 30 and 45 DAS | 137.32 | 2.96 | 50.67 |
| Control : N:P:K -60:45:45 (kg/ha) | 127.87 | 1.14 | 33.27 |
| F-Test | S | S | S |
| S. Em (±) | 3.96 | 0.11 | 1.02 |
| CD (P=0.05) | 11.87 | 0.33 | 3.06 |

Table.2 Effect of Sulphur and Boron on yield attributes and yield of Sunflower.

| Treatments | Seeds/Capitulum (No.) | Test weight(g) | Seed yield (t/ha) | Stover yield (t/ha) | Harvest index (%) |
|---|----------------------------------|---------------------------|------------------------------|--------------------------------|------------------------------|
| Sulphur 40 Kg/ha + Boron 200 ppm at 30 DAS | 281.73 | 33.45 | 1.13 | 2.07 | 35.31 |
| Sulphur 40 Kg/ha + Boron 200 ppm at 45 DAS | 295.83 | 34.24 | 1.23 | 2.19 | 31.98 |
| Sulphur 40 Kg/ha + Boron 100 ppm at 30 and 45 DAS | 312.84 | 35.16 | 1.18 | 2.58 | 32.28 |
| Sulphur 45 Kg/ha + Boron 200 ppm at 30 DAS | 282.50 | 33.67 | 1.10 | 2.64 | 29.41 |
| Sulphur 45 Kg/ha + Boron 200 ppm at 45 D.A.S | 281.78 | 34.09 | 1.11 | 2.32 | 32.36 |
| Sulphur 45 Kg/ha + Boron 100 ppm at 30 and 45 DAS | 307.82 | 35.86 | 1.27 | 2.25 | 36.07 |
| Sulphur 50 Kg/ha + Boron 200 ppm at 30 DAS | 316.11 | 36.66 | 1.31 | 2.71 | 32.58 |
| Sulphur 50 Kg/ha + Boron 200 ppm at 45 DAS | 351.82 | 37.13 | 1.37 | 3.07 | 32.58 |
| Sulphur 50 Kg/ha + Boron 100 ppm at 30 and 45 DAS | 367.86 | 40.84 | 1.48 | 3.87 | 27.66 |
| Control : N:P:K -60:45:45 (kg/ha) | 314.54 | 34.76 | 1.03 | 2.17 | 32.18 |
| F test | S | S | S | S | S |
| S. Em (±) | 5.85 | 1.28 | 0.06 | 0.21 | 0.86 |
| CD (P = 0.05) | 17.53 | 3.83 | 0.18 | 0.65 | 2.58 |