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# The effect of micronutrients applied as foliar spray on morphological & physiological growth of sesame (*Sesamum indicum* L.)

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**Abstract**
A field experiment was conducted during *kharif* season 2017 at field experiment, Department of Agronomy, Bhagwant University to study the effect of micronutrients applied as foliar spray, on morphological & physiological growth of sesame crop. The field experiments were laid out in a Randomized Block Design. All treatments recorded significantly higher morphological & physiological growth parameters over control. However, $T_9$ (mixture of all above micronutrient) recorded significantly higher plant height (cm) and yield than the other treatments. Similarly growth components were significantly higher in $T_9$ (mixture of all above micronutrient) where as control recorded significantly lower growth parameters.

**Keywords:** Sesame, foliar spray and growth

## Introduction

Sesame (*Sesamum indicum* L.) is a flowering plant in the genus *Sesamum*. Numerous wild relatives occur in Africa and a smaller number in India. It is widely grown in tropical regions around the world and is cultivated for its edible seeds, which grow in pods. Sesame is one of the important oilseed crops in Indian agriculture.

Sesame seeds are rich source of food, nutrition, edible oil and bio-medicine. Sesame oil has excellent nutritional, medicinal, cosmetic and cooking qualities for which it is known as 'the queen of oilseeds'. Due to the presence of potent antioxidants, sesame seeds are called as 'the seeds of immortality'. Sesame cake or meal obtained as a byproduct of the oil milling industry is rich in protein, vitamin (Niacin) and minerals.

The crop is grown for its seeds, which contain 50-60% oil, 8% protein, 5.8% water, 3.2% crude fiber, 18% carbohydrate, 5.7% ash and it is very rich in minerals such as Ca, P and vitamin E. Also, sesame oil has a very high level of unsaturated fatty acids, which is assumed to have reducing effect on plasma cholesterol, as well as on coronary heart disease.

The role of different micronutrients has been well established in plant metabolism. Zn, as micronutrients, is involved in the biosynthesis of auxins, indole -3-acetic acid. It participates in the metabolism of plant as an activator of several enzymes. Boron is involved in the carbohydrate transport within the plant which helps in translocation of sugar and DNA synthesis in meristems. Also it has been implicated in cellular differentiation and development, nitrogen metabolism, fertilization, active salt absorption, hormone metabolism, water relations, fat metabolism, phosphorus metabolism and photosynthesis. Molybdenum has long been implicated in gaseous nitrogen fixation and nitrate assimilation. Zinc (Zn) and manganese (Mn) are important micronutrients in sesame production. Reduced growth hormone production in Zn deficient plants causes shortening of internodes and short leaves resulting in malformation of fruit with little or no yield. Mn is essential to photosynthesis reactions, enzyme activation and root growth (Mortvedt *et al*., 1999) [7]. Therefore, the steady supply of macro nutrients and Zn was found to increase stem height and nodes for capsule development in sesame. Major micronutrients like nitrogen, phosphorus and potassium along with micronutrients such as zinc and manganese are influencing the growth and yield of sesame.

## Materials and Methods

The present investigation entitled "The effect of micronutrients applied as foliar spray, on morphological & physiological growth of sesame crop" was conducted during *kharif* season of 2017 at the Agricultural Research Farm, Bhagwant University, Ajmer Rajasthan. Theare materials used, experimental procedure followed and techniques adopted during the course of investigation are described in this chapter. The experiment consisted of 10 treatments involving one control (without foliar spray). Geographically, experimental site falls under the agro-climatic zone III A (semi-arid eastern plain zone) and located on 250 10' N latitude 820 37' E longitudes and at an altitude of 427 meters above mean sea level. The experimental of site was uniform in topography and well-drained. The experiment was laid out in randomized block design with ten treatments replicated thrice. Sesame seeds of the variety Prachi used as planting materials were procured from oil seed project of Orissa University of Agriculture and Technology, Bhubaneswar.

The experiment consisted of 10 treatments involving one control. The details of the treatments are given below.

| | |
|---|---|
| $T_1$ | Controlled ( RDF N P K 30:20:20 kg/ha ) |
| $T_2$ | Foliar spray of Boron @ 100ppm ($Na_2B_4O_7{\cdot}10H_2O$) |
| $T_3$ | Foliar spray of Zinc @ 100ppm as ($ZnSo_4$) |
| $T_4$ | Foliar spray of Mo @ 50ppm as ($NH_4Mo_7O_{24}$. $4H_2O$) |
| $T_5$ | Foliar spray of Cu @ 100ppm as ($CuSO_4$. $5H_2O$) |
| $T_6$ | Foliar spray of Fe @ 100ppm as ($FeSO_4$. $7H_2O$) |
| $T_7$ | Foliar spray of Mn @ 100ppm as ($MnSO_4$. $H_2O$) |
| $T_8$ | Foliar spray of Co @ 50ppm as ($Co(NO_3)_2$ ) |
| $T_9$ | Mixture of all above micronutrient |
| T10 | Foliar spray of Commercial micronutrient mixture (5 ml/ 2lt $H_2O$) |

## Results and Discussions

The experiment was laid out in a Randomized Block Design with ten treatments and replicated thrice. The treatments were $T_1$: control (no spray of micronutrients), $T_2$: B (100ppm), $T_3$: Zn (100ppm), $T_4$: Mo (50ppm), $T_5$: Cu (100ppm), $T_6$: Fe (100ppm), $T_7$: Mn (100ppm), $T_8$: Co (50ppm), $T_9$: (combination of above micronutrients) and $T_{10}$: commercial mixture of micronutrients. Micronutrient treatments were given to the crop at 45 and 60 DAS. Observations were recorded on growth characters of sesame.

## Morphological Traits

Plant height varied among the treatments at all the 3 stages of crop growth. Foliar application of micronutrients significantly increased the plant height which varied a minimum height of 61, 91.3 and 95.2 cm in control ($T_1$) to a maximum of 76.9, 108.8 and 109.1 cm in ($T_9$) at 45, 60 and 90 DAS respectively. Foliar application of all the micronutrients in combination ($T_9$) registered the highest plant height followed by foliar application of Zn ($T_3$), B ($T_2$), and Mo ($T_4$) among the treatments at all the growth stages.

Number of branches per plant increased significantly over control by foliar treatment of micronutrients except Cu ($T_5$). Among the treatments the highest number of branches produced in plant due to application of combined micronutrients ($T_9$) followed by Zn ($T_3$), B ($T_2$) and Mo ($T_4$).

## Physiological Traits

Growth parameters like LAI, SLA, SLW and LAR determined at 45 and 60 DAS were presented in table-6. Data indicated that higher value of LAI and SLW were found at 60 DAS where as higher value of SLA and LAR were noticed at 45 DAS in all the treatments.

Leaf area index (LAI) increased significantly due to foliar application of micronutrients which was ranged a minimum of 0.91 ($T_1$) to a maximum of 1.35 ($T_9$) at 45 DAS and 1.08 ($T_1$) to 2.24 ($T_9$) at 60 DAS. In both the stages (45 and 60 DAS) significantly the highest LAI was recorded in plants sprayed with combined micronutrients ($T_9$) followed by application of Zn ($T_3$), B ($T_2$), Mo ($T_4$) and commercial mixture ($T_{10}$).

Specific leaf area (SLA) was recorded at 45 and 60 DAS differed significantly among the treatments. At 45 DAS the highest SLA 428.8 $cm^2/g$ was recorded in control ($T_1$) and lowest 317.3 $cm^2/g$ in $T_9$ whereas at 60 DAS the SLA was highest 284.3 $cm^2/g$ in $T_5$ and the lowest 213 $cm^2/g$ recorded in $T_8$. Though significant difference in SLA was observed among the treatments in both the stages but no definite trend in influence of micronutrient spray on SLA was observed at both stages.

Specific leaf weight (SLW) recorded at 45 and 60 DAS differed significantly among the treatments. Foliar application of most of the micronutrients alone or in combination significantly increased SLW over control. At 45 DAS the maximum SLW 3.15 $mg/cm^2$ recorded in plants applied with foliar spray of combined micronutrients ($T_9$) followed by Zn ($T_3$), commercial mixture ($T_{10}$) and B ($T_2$) where as at 60 DAS, the highest SLW 4.69 $mg/cm^2$ was recorded in Co ($T_8$) followed by Fe ($T_6$) and $T_9$. The lowest value of SLW was recorded in control ($T_1$) at 45 DAS and in Fe ($T_5$) at 60 DAS.

Leaf area ratio (LAR) recorded at 45 and 60 DAS varied among the treatments. The highest LAR 210.4 and the lowest 139 $cm^2/g$ were recorded in $T_1$ and $T_2$ respectively at 45 DAS. Whereas highest LAR 68.4 and lowest 55.2 $cm^2/g$ were recorded in foliar spray of Mn ($T_7$) and combined micronutrients ($T_9$) respectively at 60 DAS. Though LAR differed among the treatments recorded at both the stages, but no definite influence of micronutrient spray on LAR was observed.

Relative growth rate (RGR) increased with foliar spray of most of the micronutrients over control but significant increase was recorded (101.3 mg/g/day) in combined micronutrients sprayed ($T_9$) followed by Zn ($T_3$).

Net assimilation rate (NAR) significantly influenced by foliar application of micronutrients. The significant increase in NAR over control was observed in case of foliar spray of all the micronutrients except Mn ($T_7$) which was at par with control. The highest NAR 1.2 $mg/cm^2$/day was recorded in $T_9$ followed by B ($T_2$) and Zn ($T_3$).

Crop growth rate (CGR) was significantly increased by application of different micronutrients as foliar spray. Among the treatments the maximum CGR 21.1 $g/m^2$/day was registered in plants applied with combined micronutrients ($T_9$) followed by Zn ($T_3$),B ($T_2$) and Mo($T_4$). The lowest CGR was recorded in control plant ($T_1$) where no micronutrient was applied.

Leaf area duration (LAD) was influenced significantly by foliar application of micronutrients. Among the treatments the highest LAD 27.01 was registered in $T_9$ followed by application of Zn (24.31), B (21.49), and Mo (20.66). The lowest LAD was recorded in control plant without micronutrients ($T_1$).

**Table 1:** Effect of different micronutrients on plant height (cm) and number of branches per plant at different growth stages.

| Treatment | Plant height (cm) | | | No. of branches /plant | | |
|---|---|---|---|---|---|---|
| | 45DAS | 60DAS | 90DAS | 45DAS | 60DAS | 90DAS |
| $T_1$ | 61.0 | 91.3 | 95.2 | 2.0 | 3.3 | 4.0 |
| $T_2$ | 70.6 | 104.5 | 106.3 | 4.6 | 6.6 | 7.3 |
| $T_3$ | 73.5 | 104.9 | 107.1 | 5.3 | 6.0 | 7.3 |
| $T_4$ | 69.3 | 101.4 | 106.0 | 4.0 | 5.3 | 6.6 |
| $T_5$ | 62.9 | 95.5 | 96.7 | 2.6 | 4.0 | 6.0 |
| $T_6$ | 66.4 | 96.7 | 98.5 | 3.3 | 5.3 | 6.0 |
| $T_7$ | 68.1 | 100.1 | 100.5 | 4.0 | 4.6 | 6.6 |
| $T_8$ | 67.0 | 98.8 | 99.0 | 3.3 | 4.6 | 6.0 |
| $T_9$ | 76.9 | 108.8 | 109.1 | 6.0 | 8.0 | 8.0 |
| T10 | 68.2 | 101.4 | 102.6 | 4.0 | 5.3 | 7.3 |
| SE(m)+ | 0.586 | 0.749 | 1.499 | 0.225 | 0.307 | 0.372 |
| C.D(0.5) | 1.74 | 2.22 | 4.45 | 0.67 | 0.91 | 1.10 |

**Table 2:** Effect of different micronutrients on LAI, SLA, SLW, and LAR at different growth stages.

| Treatments | RGR(mg/gm/day) | NAR($mg/cm^2$/day) | CGR($g/m^2$/day) | LAD |
|---|---|---|---|---|
| | 45-60 DAS | 45-60 DAS | 45-60 DAS | 45-60 DAS |
| $T_1$ | 92.5 | 0.87 | 8.7 | 14.97 |
| $T_2$ | 93.2 | 1.13 | 15.9 | 21.49 |
| $T_3$ | 95.0 | 1.05 | 16.6 | 24.31 |
| T4 | 85.2 | 0.95 | 12.9 | 20.66 |
| $T_5$ | 93.5 | 0.91 | 10.5 | 17.37 |
| $T_6$ | 91.2 | 0.96 | 11.4 | 17.90 |
| T7 | 84.4 | 0.85 | 11.4 | 20.24 |
| $T_8$ | 85.5 | 0.98 | 11.3 | 17.36 |
| $T_9$ | 101.3 | 1.20 | 21.1 | 27.01 |
| T10 | 84.4 | 0.91 | 12.2 | 20.36 |
| SE(m)+ | 0.763 | 0.001 | 0.760 | 0.596 |
| C.D(0.5) | 2.26 | 0.002 | 2.58 | 1.77 |

**Table3:** Effect of different micronutrients on RGR, NAR, CGR and LAD at different growth period.

| Treatments | RGR(mg/gm/day) | NAR($mg/cm^2$/day) | CGR($g/m^2$/day) | LAD |
|---|---|---|---|---|
| | **45-60 DAS** | **45-60 DAS** | **45-60 DAS** | **45-60 DAS** |
| $T_1$ | 92.5 | 0.87 | 8.7 | 14.97 |
| $T_2$ | 93.2 | 1.13 | 15.9 | 21.49 |
| $T_3$ | 95.0 | 1.05 | 16.6 | 24.31 |
| T4 | 85.2 | 0.95 | 12.9 | 20.66 |
| $T_5$ | 93.5 | 0.91 | 10.5 | 17.37 |
| $T_6$ | 91.2 | 0.96 | 11.4 | 17.90 |
| T7 | 84.4 | 0.85 | 11.4 | 20.24 |
| $T_8$ | 85.5 | 0.98 | 11.3 | 17.36 |
| $T_9$ | 101.3 | 1.20 | 21.1 | 27.01 |
| T10 | 84.4 | 0.91 | 12.2 | 20.36 |
| SE(m)+ | 0.763 | 0.001 | 0.760 | 0.596 |
| C.D(0.5) | 2.26 | 0.002 | 2.58 | 1.77 |

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