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# Effect of Boron Nutrition on Growth and Yield of Sunflower (*Helianthus annuus* L.)

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## ABSTRACT

A field experiment was conducted during summer 2020 to find out the effect of B on the growth and yield of sunflower (*Helianthus annuus* L.). The experiment was laid out in factorial Randomized Block Design with three replications, each comprising of 16 treatment combinations, consisting of four genotypes viz., KBSH-44 ($G_1$), KBSH-53 ($G_2$), RSFH-1887 ($G_3$), LSFH-171 ($G_4$) and four boron levels viz., no boron ($B_0$), 0.5 kg ha$^{-1}$ ($B_1$), 1.0 kg ha$^{-1}$ ($B_2$) and 1.5 kg ha$^{-1}$ ($B_3$). The study results revealed that KBSH-44 ($G_1$) was promoted by highest growth parameters like leaf number (30.4) and LAI (3.16) at 60 DAS, while highest dry matter accumulation (118.91 g plant$^{-1}$) was recorded at harvest. KBSH-44 recorded highest seed yield (1.99 t ha$^{-1}$) followed by KBSH-53. However oil yield (764.9 kg ha$^{-1}$) was highest with KBSH-53 followed by RSFH-1887 (715.1 kg ha$^{-1}$). Among the different boron levels, $B_3$ i.e. Boron @1.5 kg ha$^{-1}$ recorded highest plant height (199.1 cm), dry matter accumulation (117.43 g plant$^{-1}$) at harvest, number of leaves (30.8) and LAI (3.15) at 60 DAS. The highest growth parameters such as number of leaves, LAI and dry weight resulted in highest seed (2.10 t ha$^{-1}$) and oil (743.6 kg ha$^{-1}$) yield with soil application of boron @ 1.5 kg ha$^{-1}$ followed by $B_2$, $B_1$ and $B_0$.

**Keywords** Sunflower, Soil application of boron, Growth, Yield.

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## INTRODUCTION

Sunflower (*Helianthus annuus* L.) one of the major oilseed crops, is widely cultivated in the world. After groundnut and soybean, sunflower ranks third in the world for total production of oilseeds (Ramula *et al.* 2011). It is grown extensively in peninsular India, primarily as a rainfed crop during monsoon season and to a certain extent in the post rainy season. Infact over the years, the crop has been replacing many of the traditionally grown crops such as sorghum, Bengal gram. With the emphasis on attaining self-sufficiency in oilseed production, there has been a national effort in encouraging its cultivation. Sunflower cultivation and hybrid seed production has gained new dimension after the launch of New Seed Policy in 1988. It resulted in the import of exotic hybrids and germplasm lines, which subsequently helped to diversify genetic base of sunflower cultivars grown in India. In coming years, major emphasis is to be placed on increasing productivity and yield stability across environments (Kala *et al.* 2012).

Non-availability of seeds of hybrid and high yielding varieties suited for different agro climatic areas, improper nutrient managements, bird damage and incidence of several diseases and insect pests lead to poor crop growth, yield attributing characters and seed yield. Among different micronutrient deficiencies, boron deficiency is the second most dominant problem globally. Boron (B) is one of the micro-nutrients required for normal growth and plant development of many crops. Sunflower is sensitive to boron deficiency and is sometimes used as an indicator for assessing available boron in soils. Soil application of boron is reported to improve harvest index (HI) and high oil percentage in sunflower (Oyinlola 2007). Boron requirement of most of the crops is higher during reproductive growth stage of the crops where the applied boron improved the fruit set and total grain yield (Zahoor *et al.* 2011).

## MATERIALS AND METHODS

A field study was conducted during summer season of 2019-20 at Instructional Farm of the Department of Agronomy, College of Agriculture, OUAT, Bhubaneswar which lies at 20°15´N latitude and 85°52´E longitude, respectively with an altitude of 25.9 m above the mean sea level and at about 64 km away from the Bay of Bengal. The soil was sandy loam in texture with pH (5.89), organic carbon (0.22%), total nitrogen (165 kg $ha^{-1}$), available phosphorus (23.3 kg $ha^{-1}$), available potash (36.0 kg $ha^{-1}$) and available boron (0.40 mg $kg^{-1}$). The experiment was conducted with four genotypes ($G_1$: KBSH-44, $G_2$ : KBSH-53, $G_3$ : RSFH-1887 and $G_4$ : LSFH-171) and four levels of boron ($B_0$ : 0 kg $ha^{-1}$, $B_2$ : 0.5 kg $ha^{-1}$, $B_3$ : 1.0 kg $ha^{-1}$, $B_4$ : 1.5 kg $ha^{-1}$) with a total of 16 treatment combinations, laid out in a Factorial Randomized Block Design (FRBD) with three replications. Sowing was done at 5cm depth in furrows drawn by hand-hoe and covered manually, following the recommended seed rate i.e. 5 kg $ha^{-1}$. The size of each plot was 4.2 m × 4.2 m and the spacing adopted was 60 cm × 30 cm. Well decomposed FYM was incorporated into the soil at final ploughing @ 5 t $ha^{-1}$. Inorganic fertilizers @ 60 : 80 : 60 kg N, $P_20_5$ and $K_20$ $ha^{-1}$ were applied to all the plots through Urea, SSP and MOP. Full P and K + half N were applied as basal, 25% N were top dressed at 30 days after sowing and rest 25% N at 45 DAS. Boron was also applied as per the treatment in the form of borax. Intercultural operations were done as and when required. Total 5 irrigations were given including pre-sowing irrigation at 12 days interval. The mature flower heads were harvested when the thalamus dropped down with its color changing to yellow.

## RESULTS AND DISCUSSION

### Growth parameters and yield

Among the different test hybrids, the maximum plant height was recorded with KBSH-53 (200 cm) which was however at par with RSFH-1887 (194 cm) and KBSH-44 (187.1 cm) (Table 1). Maximum number of leaves (30.4) and highest LAI (3.16) was observed with KBSH-44 which was at par with KBSH-53 (29.6 and 3.02 respectively) and RSFH-1887 (28.9 and 2.84 respectively) at 60 DAS and minimum number of leaves and lowest LAI with LSFH-171. The highest dry matter was recorded with KBSH-44 (118.91g $plant^{-1}$) which is significantly superior over the other three hybrids and was at par with KBSH-53 (114.11g $plant^{-1}$). Wable (2016) found that among different hybrids, KBSH-44 recorded highest dry matter. Maximum CGR was recorded with RSFH-1887 (11.79g $d^{-1}m^{-2}$) followed by KBSH-53 and KBSH-44. The differences in most growth characteristics may be attributed to genetic factors and their interaction with the prevailing environmental conditions (Al-Doori 2014).

Highest plant height (199 cm) was achieved with soil application of boron @1.5 kg $ha^{-1}$ ($B_3$) and the lowest plant height was observed with no boron application. $B_3$ recorded the highest LAI (3.15) which was on par with $B_2$ (application of B @1.0 kg $ha^{-1}$). Application of boron @ 1.5 kg $ha^{-1}$ increased dry matter to maximum extent when compared to other boron levels and the least was recorded by control where no boron was applied. Ahmed *et al.* (2011) also reported that dry matter yield increased significantly with B up to 2.0 kg $ha^{-1}$. Exogenous application of B reportedly responded in increasing plant dry matter (Oyinlola 2007). Increased biomass production by the applica-

**Table 1.** Growth and yield of sunflower as influenced by genotypes and boron levels.

| Treatment | Pl ht (cm) | No. of leaves (60 DAS) | LAI (60 DAS) | Dry wt/plant (g) | CGR (g $d^{-1}$ $m^{-2}$) | Seed yield (t/ha) | Oil yield (kg/ha) |
|---|---|---|---|---|---|---|---|
| Genotypes | | | | | | | |
| $G_1$ KBSH-44 | 187.1 | 30.4 | 3.16 | 118.9 | 11.67 | 1.99 | 685.8 |
| $G_2$ KBSH-53 | 199.6 | 29.6 | 3.02 | 114.1 | 11.77 | 1.91 | 764.9 |
| $G_3$ RSFH-1887 | 194.3 | 28.9 | 2.84 | 112.7 | 11.79 | 1.85 | 715.1 |
| $G_4$ LSFH-171 | 170.9 | 25.6 | 2.52 | 88.2 | 9.57 | 1.73 | 540.5 |
| SEm ± | 5.54 | 0.73 | 0.097 | 1.4 | 0.4 | 0.06 | 23.64 |
| CD (0.05) | 16.0 | 2.1 | 0.28 | 4.1 | 1.2 | 0.18 | 68.28 |
| Boron levels | | | | | | | |
| $B_0$ No boron | 177.2 | 26.6 | 2.64 | 98.17 | 10.09 | 1.64 | 600.1 |
| $B_1$ 0.5 kg | 183.5 | 27.7 | 2.72 | 105.43 | 10.65 | 1.77 | 636.2 |
| $B_2$ 1.0 kg | 192.1 | 29.9 | 3.03 | 112.88 | 11.80 | 1.98 | 726.4 |
| $B_3$ 1.5 kg | 199.1 | 30.8 | 3.15 | 117.43 | 12.25 | 2.10 | 743.6 |
| SEm ± | 5.54 | 0.73 | 0.097 | 1.43 | 0.41 | 0.06 | 23.64 |
| CD (0.05) | 16.0 | 2.1 | 0.28 | 4.1 | 1.2 | 0.18 | 68.28 |
| Interactions | | | | | | | |
| SEm ± | 11.07 | 1.45 | 0.19 | 2.86 | 0.82 | 0.12 | 47.29 |
| CD (0.05) | NS | NS | NS | NS | NS | NS | 136.55 |

tion of boron is thought due to role of boron in cell elongation, photosynthesis and transpiration (Brown and Hu 1996). The results also revealed that different sunflower hybrids and boron levels have a significant effect onseed and oil yield. However the interaction effect seemed to be non-significant. The highest seed (1.99 t $ha^{-1}$) was obtained from KBSH-44 while the lowest was recorded in LSFH-171 with corresponding value of 1.73 t $ha^{-1}$. Barmaki *et al.* (2009) revealed that the yield of sunflower differed due to performance of different sunflower hybrids to weather and management practices. The highest oil yield (764.9 kg $ha^{-1}$) was obtained with KBSH-53 which might be due to more oil content than KBSH-44 and RSFH-1887. The results obtained are in agreement with the Kalaiyarasan *et al.* (2019) who reported maximum oil content (33.61%) with KBSH-53. Highest seed (2.10 t $ha^{-1}$) and oil yield (743.6 kg $ha^{-1}$) were recorded with B @ 1.5 kg $ha^{-1}$ ($B_3$) which remained at par with $B_2$ and the lowest values were observed with control. Renukadevi and Savithri (2003) found that enhanced uptake of boron resulted in significant increase in achene oil contents.

## CONCLUSION

KBSH-44 gave the highest yield and the best performing variety which remained at par with KBSH-53 and RSFH-1887. Oil yield was maximum for KBSH-53 followed by RSFH-1887 and KBSH-44. Soil application of boron @1.5 kg/ha recorded maximum growth parameters, seed and oil yield which remained at par with soil application of boron @ 1.0 kg/ha.

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