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Original Research Article

Effect of Micronutrients on Growth, Yield and Quality of Sunflower in Kharif Season

Manjushri B. Kawade, D.B. Jadhav* and S.P. Arshewar

Agronomy Section, College of Agriculture, VNMKV, Latur (M.S) 413512, India
**Corresponding author*

Keywords

Micronutrients Growth, Yield, Quality, Sunflower, Kharif Season

A B S T R A C T

A field experiment was conducted during *kharif* season of 2016 at the Experimental Farm of Agronomy Section, College of Agriculture, Latur to study the response of hybrid sunflower to micronutrient in *kharif* season. The topography of experimental field was uniform and leveled. The soil of the experimental site was clayey in texture. Soil with available nitrogen (129.31 kg ha^{-1}), available phosphorous (20.42 kg ha^{-1}) and available potassium (295.89 kg ha^{-1}) content and alkaline in reaction having p^{H} of 8. The experiment was laid out in Randomized Block Design (RBD). The result indicated that yield of sunflower were significantly influenced by different micronutrients. The maximum leaf area plant^{-1} (76.97 dm^{2}), stem girth (8.09 cm), head diameter plant^{-1}(18.83cm), seed yield (1644 kg ha^{-1}), oil yield (575 kg ha^{-1}) and protein yield (312 kg ha^{-1}) with RDF + Borax @ 5.0 kg ha^{-1} (T_{10}). The higher stalk yield (3676 kg ha^{-1}) and biological yield (5084 kg ha^{-1}) by application of RDF along $FeSO_4$ @ 10 kg ha^{-1} (T_5).

Introduction

Oil seed crops occupy an important position next to food grains in Indian economy. The oil not only forms an essential part in human diet but also serves as an important raw material for manufacture of various products like flavour enhancers, lubricants etc.

Sunflower *(Helianthus annuus* L.) is one of the most popular members of the family Asteraceae and is one of the world's most important sources of vegetable oil. The native of the sunflower is reported to be Southern parts of USA and Mexico. Sunflower crop was introduced to India during 1969 and the commercial cultivation of sunflower started during 1972-73 with a few imported varieties from USSR and Canada. Now the crop is well adopted by the farming community because of its desirable attributes such as short duration, photoperiod insensitivity, adaptability to wide range of soil and climatic conditions, drought tolerance, lower seed rate, higher seed multiplication ratio and high quality of edible oil (45-50%) (Reddy *et al.*, 2007).

Sunflower crop has the yield potential of around 2.3 to 2.5 tonnes ha^{-1} under favourable conditions but average productivity level in India is only 0.6 tonnes ha^{-1}. The main reasons for low productivity of sunflower is poor seedling vigour, poor seed setting and high per cent of chaffy seeds in the centre of the capitulum. Reddy *et al.*, 2007 opined that, inadequate and imbalanced nutrient supply is the reason for low productivity of sunflower. In recent years, micronutrient deficiencies and their impact on crop yields are widely reported in various parts of the country (Singh, 2008). Further, the response of annual oilseed crops to primary, secondary and micronutrient is significant, emphasizing the need for ensuring adequate nutrient supply to oilseeds (Hegde and Sudhakara Babu, 2002). Micronutrients are of growing importance in crop nutrition because of increased demand from higher yielding crops and intensive cropping, continued expansion of cropping and forestry on marginal land with low inherent levels of micronutrients, increased use of high-analysis fertilizers containing low levels of micronutrients and decreased use of manures, composts and crop residues in some parts of the world.

Materials and Methods

A field experiment was conducted during *kharif* season of 2016 at Experimental Farm of Agronomy Section, College of Agriculture, Latur to study the response of hybrid sunflower to micronutrient in *kharif* season. The soil of the experimental site was clayey in texture. Soil with available nitrogen (129.31 kg ha^{-1}), available phosphorous (20.42 kg ha^{-1}) and available potassium (295.89 kg ha^{-1}) content and alkaline in reaction having p^H of 8.

The experiment was laid out in Randomized Block Design (RBD). The ten treatments were replicated thrice. The treatments were T_1 - RDF (90:45:45 NPK kg ha^{-1}), T_2 - RDF + $ZnSO_4$ @ 10 kg ha^{-1}, T_3 - RDF + $ZnSO_4$ @ 20 kg ha^{-1}, T_4 - RDF + $ZnSO_4$ @ 30 kg ha^{-1}, T_5 - RDF + $FeSO_4$ @ 10 kg ha^{-1}, T_6 - RDF + $FeSO_4$ @ 20 kg ha^{-1}, T_7 - RDF + $FeSO_4$ @ 30 kg ha^{-1}, T_8 - RDF + Borax @ 2.0 kg ha^{-1}, T_9 - RDF + Borax @ 3.5 kg ha^{-1}, T_{10} - RDF + Borax @ 5.0 kg ha^{-1}. The gross and net plot size was 5.4 X 4.5 m^2 and 4.2 X 3.9 m^2 respectively. Sowing was done on 24^{th} July 2016 and harvested at 23^{rd} October 2016.

Results and Discussion

Growth attributes

The growth characters *viz*., lead area $plant^{-1}$ (dm^2), stem girth (cm), head diameter $plant^{-1}$ (cm) and leaf area index were significantly influenced by different treatments (Table. 1)

Leaf area $plant^{-1}$

Highest leaf area $plant^{-1}$ (76.97 dm^2) was recorded due to the application of RDF + Borax @ 5.0 kg ha^{-1} (T_{10}) at 60 DAS. The maximum leaf area may be in response to the micronutrient application.

Boron can influence photosynthesis and respiration and activate a number of enzymatic systems of protein and nucleic acid metabolism in plants (Kibalenko, 1972) resulted in producing higher leaf area $plant^{-1}$. These results are in line with Ramulu *et al.* (2011).

Stem girth

Maximum stem girth (8.09 cm) was observed due to the application of RDF + Borax @ 5.0 kg ha^{-1} (T_{10}) which was followed by RDF + $ZnSO_4$ @ 30 kg ha^{-1} (T_4). However, lowest stem diameter (6.37 cm) was observed where only RDF was applied.

Higher stem girth with (T_{10}) these results might be due to efficient carbohydrate transport and sugar translocation and increased by borate-sugar complex formation and effect of boron deficiency on cell enlargement in growing tissues as it is involved in cell structure. The experimental result was coincided with the finding of O‟Neill *et al.* (2004) and Silva *et al*. (2011). Tahir *et al.* (2014) also recorded maximum stem diameter (2.21 cm) when boron was used at the rate of 4 kg ha^{-1}

Head diameter $plant^{-1}$

Significantly highest head diameter (18.82 cm) was observed when RDF + Borax @ 5.0 kg ha^{-1} (T_{10}) were applied. Lowest head diameter (14.96 cm) was recorded due to the application of RDF. This might be due to increase in pollen-production capacity of anthesis and pollen grain viability with boron application. These results are in conformity with those of Renukadevi *et al.* (2003) and in line with Kapila S. and Shivay (2008). Significantly highest head diameter (18.77 cm) was observed by Tahir *et al.* (2014) when boron was used at the rate of 4 kg ha^{-1}. These results are according to the findings of Somroo *et al.* (2007), Oyinlola (2007) and Reddy *et al.* (2003).

Leaf area index

The higher leaf area index was observed due to the application of RDF + Borax 5.0 kg ha^{-1} (T_{10}) at all the growth stages of crop. Such response mainly due to dominant role played by boron in improving the photosynthetic ability and assimilating capacity of crop by being a component in various enzymatic and other biochemical reactions.

Due to significantly higher leaf area and LAI recorded in T_{10}, leaves might have contributed to higher net photosynthesizing area. Ramulu *et al.* (2011) recorded higher LAI (0.73) of sunflower due to application of B 12.5 kg ha^{-1} over control. These results are in line with Al- Amery *et al.* (2011) who investigated that the higher levels of boron leading to greater LAI of sunflower presumably through improved leaf area duration.

Yield of sunflower

Seed yield

Yield increase due to increase in all the growth and yield attributes. The better partitioning of photosynthates from source to sink might have led to higher yield attributes, which finally resulted in higher seed yield of sunflower. Seed yield (1644 kg ha^{-1}) was found greater with T_{10}. The B application improved the seed yield because it maintains good balance between photosynthesis and respiration. The primary function of the element is to provide structural integrity to the cell wall in plants. Borax is a constitute of cell membrane and is essential for cell division. Application of both Zn and B increased yield as compared to control (Gitte *et al*. (2005).The results of investigation are in line with those of Oyinlola, (2007) and Patil *et al.* (2006a).

Biological yield

It was not influenced significantly due to application of Zn, Fe and B, however highest values of biological yield were recorded due to the application of RDF + $FeSO_4$ @ 10 kg ha^{-1}(T_5) as this treatment produced higher stalk yield compared to others.

Quality parameters

Oil content was not influenced significantly due to application of Zn, Fe and B, however highest value of oil content (35.03 %) was recorded by the application of RDF + Borax @ 5.0 kg ha^{-1} (T_{10}) which was followed by the application of RDF + $ZnSO_4$ @ 30 kg ha^{-1} (T_4) (34.70%) and RDF + FeSO4 @ 30 kg ha^{-1} (T_7) (34.23%).

Table.1 Effect of different treatments on growth attributing characters of sunflower

Treatments	Leaf area plant^{-1} (dm^2)	Stem girth (cm)	Head diameter plant^{-1} (cm)	Leaf area index
T_1 – RDF (90:45:45 NPK kg ha^{-1})	57.40	6.37	14.96	3.19
T_2 – RDF + $ZnSO_4$ @ 10 kg ha^{-1}	63.08	7.12	16.05	3.50
T_3 – RDF + $ZnSO_4$ @ 20 kg ha^{-1}	71.86	7.61	17.34	3.99
T_4 – RDF + $ZnSO_4$ @ 30 kg ha^{-1}	74.07	7.94	18.13	4.12
T_5 – RDF + $FeSO_4$ @ 10 kg ha^{-1}	60.48	6.84	15.88	3.36
T_6 – RDF + $FeSO_4$ @ 20 kg ha^{-1}	66.05	7.26	16.52	3.67
T_7 – RDF + $FeSO_4$ @ 30 kg ha^{-1}	73.23	7.81	17.93	4.07
T_8 - RDF + Borax @ 2.0 kg ha^{-1}	59.85	6.62	15.46	3.33
T_9 – RDF + Borax @ 3.5 kg ha^{-1}	69.11	7.47	17.03	3.84
T_{10} – RDF + Borax @ 5.0 kg ha^{-1}	76.97	8.09	18.83	4.28
SE±	3.87	0.36	0.79	-
C.D. at 5 %	11.51	1.08	2.36	-
General mean	**67.21**	**7.31**	**16.81**	3.73

Table.2 Effect of different treatments on yield of sunflower

Treatment	Seed yield (kg ha^{-1})	Stalk yield (kg ha^{-1})	Biological yield (kg ha-^{1})
T_1 – RDF (90:45:45 NPK kg ha^{-1})	1258	3328	4586
T_2 – RDF + $ZnSO_4$ @ 10 kg ha^{-1}	1392	3234	4626
T_3 – RDF + $ZnSO_4$ @ 20 kg ha^{-1}	1524	2986	4510
T_4 – RDF + $ZnSO_4$ @ 30 kg ha^{-1}	1587	2530	4117
T_5 – RDF + $FeSO_4$ @ 10 kg ha^{-1}	1408	3676	5084
T_6 – RDF + $FeSO_4$ @ 20 kg ha^{-1}	1451	3090	4541
T_7 – RDF + $FeSO_4$ @ 30 kg ha^{-1}	1561	2817	4378
T_8 - RDF + Borax @ 2.0 kg ha^{-1}	1313	3224	4537
T_9 – RDF + Borax @ 3.5 kg ha^{-1}	1508	2965	4473
T_{10} – RDF + Borax @ 5.0 kg ha^{-1}	1644	2573	4217
SE±	78	223	237
C.D. at 5 %	232	663	NS
General mean	**1465**	**3042**	**4507**

Table.3 Effect of different treatments on quality parameter of sunflower crop

Treatment	Oil content (%)	Oil yield (kg ha-1)	Protein content (%)	Protein yield (kg ha-1)
T_1 – RDF (90:45:45 NPK kg ha^{-1})	33.13	417	16.00	198
T_2 – RDF + $ZnSO_4$ @ 10 kg ha^{-1}	33.72	470	17.50	244
T_3 – RDF + $ZnSO_4$ @ 20 kg ha^{-1}	34.00	518	18.40	280
T_4 – RDF + $ZnSO_4$ @ 30 kg ha^{-1}	34.70	551	19.63	311
T_5 – RDF + $FeSO_4$ @ 10 kg ha^{-1}	33.30	469	17.40	245
T_6 – RDF + $FeSO_4$ @ 20 kg ha^{-1}	33.39	485	18.30	265
T_7 – RDF + $FeSO_4$ @ 30 kg ha^{-1}	34.23	534	19.33	302
T_8 - RDF + Borax @ 2.0 kg ha^{-1}	33.21	436	16.30	213
T_9 – RDF + Borax @ 3.5 kg ha^{-1}	33.77	510	18.23	275
T_{10} – RDF + Borax @ 5.0 kg ha^{-1}	35.03	575	18.97	312
SE±	0.47	28	0.84	15.8
C.D. at 5 %	NS	83	NS	47
General mean	33.85	**496**	18.01	**265**

The minimum oil content was observed (33.13%) where RDF alone was applied. This might be due to after pollination and seed set, the formation of protein start and there after oil synthesis start and boron is very crucial for carbohydrate and lipid metabolisms and hence the oil content.. Similarly highest percentage of oil content was recorded by Oyinlola (2007), Ceyhan *et al.* (2008) and Renukadevi and Savithri (2003) due to the B application.

Oil yield is a function of integrated effects of the various components. Application of boron had brought out a tremendous increase in the oil yield of sunflower. Soil application of 5 kg boron ha^{-1} along with RDF (T_{10}) was recorded the highest oil yield (575 kg ha^{-1}). The significant increase in oil yield might be due to the increase in oil content as well as seed yield per unit area with RDF + Borax @ 5.0 kg ha^{-1} (T_{10}**).** These results are according to the findings as reported by Ceyhan *et al.* (2008) and Renukadevi and Savithri (2003).

References

Al-Amery, M. M., Hamza, J. H. and Fuller, M. P. 2011. Effect of boron foliar application on reproductive growth of sunflower (*Helianthus annuus* L.). Hindawi Publishing Corporation , *Int. J. of Agron.*Article ID 230712.

Aravinda Kumar, B. N., Bhat, S. N. and Shanwad, U. K. 2010. Effect of micro nutrients on growth and yield of sunflower *(Helianthus annuus). Curr. Adv. in Agril. Sci.,* 2 (1): 51-52.

Ceyhan, E., Onder, M., Ozturk, O., Harmankay, M., Hamurcu, M. and Gezgin, S. 2008. Effect of application of boron on yield, yield components and oil content of sunflower in boron-deficit calcarious soils. *African. J. of Biotec.,* 7 (16): 2854-2861.

Fred, D. B. da Silva, Leonardo, A. de Aquino, Luis, E. P., Tricic C. L., Paulo G.B. and Denise C. Fernandes, 2016. Influence of boron on sunflower yield and nutritional status. Communications in Soil Science and Plant Analysis .http://dx.doi. org/10.1080 /00103624. 2016.1146894.

Gitte, A. N., Patil, S. R. and Tike, M. A. 2005. Influence of zinc and boron on biochemical and yield characteristics of sunflower. *Ind. J. Plant Physiol*., 10: 400-403.

Hegde, D. M. and Sudhakara Babu, S. N. 2002. Declining factor productivity and improving nutrient use efficiency in oilseeds. *Indian J. of Agron.*, 54 (1):1-8.

Kapila S. and Shivay, Y. S. 2008. Effect of nitrogen sources, Sulphur and boron levels on productivity, nutrient uptake and quality of sunflower (*Helianthus annuus*). *Indian J. of Agron*. 53(2): 129-134.

Kibalenko, A. P. 1972. Investigations on the influence of the boron on nucleic acid metabolism. *Thaer-Arch.* 14: 725-737.

O‟Neill,M.A.,Ishii, T., Albersheim, P., Darvill, A.G.2004. Rhamnogalacturonanll: structure and function of borate cross-linked cell wall pectic polysaccharide. *Annual review of plant Bio*., 55: 109-139.

Oyinlola, E. Y. 2007. Effect of boron fertilizer on yield and oil content of three sunflower cultivars in the Nigerian Savanna. *J. of Agron.*, 6 : 421-426.

Patil, S. B., Vyakaranahal, B. S., Deshpande, V. K. and Shekhargouda, M. 2006 a. Effect of

Boron and Zinc application on seed yield and quality of sunflower restorer line, RHA-857. *Karnataka J. of Agric. Sci.*, 19(3): 708-710.

Rai, M. M and Dighe. 1971. Response of added B to maize and choice of extractant for B. *JNKVV- Research Journal*, 5(2): 120-122.

Reddy, N. Y. A., Shaanker, R .U., Prasad, T. G. and Kumar, M. U. 2003. Physiological approaches to improve harvest index and productivity in sunflower. Helia., 26: 81-90.

Renukadevi, A., Savithri, P. and Andi, K. 2003. Sources, levels and methods of boron application on the dry matter production yield attributes and yield of sunflower *(Helianthus annuus)* crop. *Crop Res.*, 25(3): 436- 440.

Silva, C. A. T., Cagolm, A., Silva, T. R. B., Nobrega, L. H. P. 2011. Boron application before sowing of sunflower hybrid. J. Food Agri. Enviro., 9:580-583.

Singh, M. V. 2008. Micronutrient deficiencies in crops and soils in India.In: Micronutrient deficiencies in global crop production (Ed. Alloway, B. J. and Graham, R. D.)

Sinha, R. B., Sakal, R., Singh, A. P. and Bhogal, N. S. 1991. Response of some field crops to B application in calcareous soil. *J. Indian Soc. Soil Sci.,* 39: 118-122.

Somroo, S. A., Bhutta, A. R., Durrani, S. R. and Oad, C. F. 2007. Assessment of foliar and broadcast application of boron on growth and yield of sunflower (*Helianthus annuus* L.). *Pak. J. Seed Tech*., 1:54-62.

Sumathi, P., Nirmalakumari, A., Muralidharan, V. 2005. Pollen use efficiency of sunflower (*Helianthus annuus* L.) lines cms 234 A and RHA 6D-1. Helia, 28(43): 99-106.

Tahir, M., Younas Ishaq M., Sheikh, A. A., Naeem, M. and Rehman, A. 2014. Effect of boron on yield and quality of sunflower under Agro- ecological conditions of Faisalabad (Pakistan). *Scientia Agriculturae* 7 (1): 19-24.