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EFFECT OF SULPHUR AND BORON ON GROWTH AND YIELD OF HYBRID SUNFLOWER

Kalaiyarasan C.[1*], D. Tamizhselvan[1], S. Jawahar[1], S. Ezhilkumar[2], K. Suseendran[1], S. Madhavan[3] and S. Ramesh[1]

[1*]Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar-608 002 (Tamil Nadu), India.
[2]Department of Genetics and Plant Breeding, Faculty of Agriculture, Annamalai University, Annamalai Nagar - 608 002 (Tamil Nadu), India.
[3]Department of Horticulture, Faculty of Agriculture, Annamalai University, Annamalai Nagar-608 002, (Tamil Nadu), India.

Abstract

The Field investigations were conducted in two locations *viz.*, at Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu during March – June 2013 and at farmers field at Ko-Chathiram village, Kurinjipadi block, Cuddalore district, Tamil Nadu during July- October 2013 to study the effect of different levels of sulphur and boron on growth, yield attributes and yield of hybrid sunflower cv. Sunbred. The treatment consisted of sulphur with five levels (0, 15, 30, 45, 60 kg S ha^{-1}) and three levels of boron (0, 0.5, 1.0 kg B ha^{-1}). Totally fifteen treatments were tested and were laid out in factorial concept of randomized block design with three replication. The results revealed that growth, yield attributes and yield was significantly influenced by various S and B levels Among the treatment combinations tried, 60 kg S ha^{-1} with B @ 1 kg ha^{-1} has a spectacular effect on growth and yield attributes, ultimately leading to maximum seed yield (2573.25 and 2673.84 kg ha^{-1}) in both the crops. The lowest values of growth and yield attributes and yield were recorded by 0 kg S ha^{-1} with B @ 1 kg ha^{-1}.

Key words : Sulphur, Boron, hybrid sunflower.

Introduction

In the agricultural economy of India, oilseeds are important next only to food grains in terms of acreage, production and value. India is the largest producer of oilseeds in the world in terms of output. Tamil Nadu is one of the major oilseeds producing state in India. The major edible oilseed crops grown in this state are peanut, sesame, sunflower etc., Among the oilseed crops, sunflower (*Helianthus annuus* L.) is an all season crop. Holds great promise as an oilseed crop because of its short duration, photo-in-sensitivity and wide adaptability to different agro-climatic regions and soil types. Sunflower seed contains about 48-53 percent edible oil. Sunflower oil is a rich source of linoleic acid (64 percent) which is good for heart patients. The oil is also used for manufacturing hydrogenated oil. Sunflower can play an important role in meeting out the shortage of edible oils in the country. With the improvement of crop productivity through the adoption of high-yielding varieties and multiple cropping systems, fertilizer use has become more and more important to increase crops yield and quality. After N, P and K, S is the fourth nutrient, whose deficiency is widespread in India (Sakal *et al.*, 2001). Sulphur deficiency is observed primarily due to high crop yield and therefore higher rate of S removal by crops, and lesser use of S containing fertilizers (Messick, 2003). S is an essential plant nutrient for crop production. For oil crop producers, S fertilizer is especially important because oil crop require more S than cereal grains. S is best known for its role in the formation of amino acids methionine (21% S) and cysteine (27% S); synthesis of proteins and chlorophyll; oil content of the seeds and nutritive quality

***Author for correspondence :** E-mail: kalai77.agri@gmail.com

of forages (Jamal *et al.*, 2005). An sufficient S supply can affect yield and quality of the crops, caused by the S requirement for protein and enzyme synthesis as well it is a constituent of the amino acids, methionine and cysteine. As like sulphur, boron (B) is also one of the micronutrients required for normal growth and development of many crops. The role of B in plant has been proposed including functions in cell wall structure, cell wall synthesis sugar translocation, cell division, enzymatic reactions and plant growth regulation (Blevins and Lukaszewski, 1998). Sunflower is one of the most sensitive crops to B deficiency. B deficiency symptoms in sunflower become evident on leaves, stems, reproductive parts, dry matter, yield components and seed yield (Blamey *et al.,* 1997). Asad *et al*., (2002) reported that B requirement of sunflower during reproductive growth is higher than during vegetative growth. Boron foliar spray may help in the processes of pollination and better seed filling of sunflower. With above said points, the experiment was conducted to enhance growth and yield of sunflower by using sulphur and boron.

Materials and Methods

Field investigations were conducted during March – June 2013 at Experimental Farm, Department of Agronomy, Faculty of Agriculture, Annamalai University, Annamalai Nagar, Tamil Nadu and at farmers field at Ko-Chathiram village, Kurinjipadi block, Cuddalore district, Tamil Nadu during July- October 2013. The soil of the experimental field is clay loam and sandy clay loam in texture. The nutrient status of the experimental soil was low in nitrogen, medium in phosphorus, high in potassium and low in sulphur. Sunflower hybrid sunbred was chosen for this study. The experiment consisted of fifteen treatments and was laid out in factorial randomized block design with three replications. The treatments imposed in the experiment are different sulphur levels (0, 15, 30, 45, 60 kg S ha^{-1}) through gypsum were tried along with different boron levels (0, 0.5, 1.0 kg B ha^{-1}) through Borax. Recommended dose of 60:90:60 kg of N, P and K ha^{-1} was applied in the form of Urea and DAP and MOP respectively. Half the dose of N and entire dose of P and K were applied basally. The remaining quantity of N was applied at 30 DAS.

Results and Discussion

Growth attributes (Table 1)

Application of different levels of sulphur was found to influence the growth attributes *viz.,* plant height, LAI, DMP, chlorophyll content and days to fifty percent flowering. The growth attributes were significantly enhanced by application of sulphur @ 60 kg S ha^{-1}. This response is due to deficiency of sulphur in experimental soil. This might be due to synthesis of more amino acids, increase in chlorophyll content in growing region and enhanced photosynthetic activity, ultimately enhancing cell division which by increased the crop growth rate. This was evidenced through the studies of Indodia and Tomer (1997).

Among the different levels of boron, application of boron @ 1 kg B ha^{-1}(B_2) significantly influenced the growth attributes over other levels. This might be due to location of sugar, cell wall synthesis and maintenance of membrane integrity, RNA, IAA and phenol metabolism. External application of boron was found to increase the vegetative and reproductive growth of the sunflower plant (Asad *et al.,* 2003).

The interaction effect between sulphur and boron was significant on growth attributes at all stages of crop growth. The highest values for growth attributes *viz.,* plant height, LAI, DMP, chlorophyll content and days to fifty percent flowering was recorded under the treatment combination of S_4B_2 (60 kg S ha^{-1} with B @ 1 kg ha^{-1}). The minimum values for growth attributes recorded under the treatment S_0B_0 (0 kg S ha^{-1} with B @ 0 kg ha^{-1}) which could be due to inadequate availability of nutrients.

Yield attributes (Table 2)

Application of sulphur influenced significantly the yield attributes in both crops. Application of 60 kg S ha^{-1} significantly increased the head diameter, number of seeds $head^{-1}$, number of filled seeds $head^{-1}$, seed filling percent and 100 seed weight over other levels. Sulphur is known to play a vital role in the formation of amino acids, had favourable effect on yield attributes due to proper portioning of photosynthetic from source to sink. These findings are in conformity with reports of Syed Shuja Hussain *et al.,* (2011).

Boron levels significantly influenced the yield attributes in both crops. Application of boron @ 1 kg B ha^{-1}(B_2) significantly influenced the yield attributes over other levels. This might be due to the role of boron in cell elongation, photosynthesis, translocation of sugars and transpiration. These results are in harmony with those obtained by Renukadevi *et al.,* (2003).

The interaction between sulphur and boron levels was found significant in both the crops. The higher seed yield was registered under the treatment combination of S_4B_2 (60 kg S ha^{-1} with B @ 1 kg ha^{-1}). This might be due to availability of sulphur, boron and other nutrients at both vegetative and reproductive stages. These findings were earlier reported by Raja *et al.,* (2007).

Table 1: Effect of different levels of sulphur and boron on growth attributes of sunflower.

Treatments	Plant height (cm)		LAI at flowering stage		DMP (Kg ha^{-1}) (at harvest)		Total Chlorophyll (mg g^{-1})		Days to 50% flowering	
	I crop	II Crop	I crop	II Crop	I crop	II Crop	I crop	II Crop	I crop	II Crop
Sulphur										
S_0	126.94	149.20	3.80	3.88	4039.72	4139.79	0.60	0.56	60.33	61.37
S_1	140.86	151.45	3.97	4.05	4273.54	4374.65	0.68	0.69	58.37	59.16
S_2	142.10	153.39	4.06	4.14	4572.91	4672.88	0.72	0.71	56.12	57.09
S_3	150.60	155.22	4.20	4.28	4814.71	4914.60	0.77	0.79	54.51	55.28
S_4	153.18	156.58	4.35	4.42	4996.11	5093.34	0.84	0.83	51.14	52.31
S.Ed	1.01	0.62	0.018	0.018	21.14	14.97	0.008	0.007	0.32	0.35
CD(P = 0.05)	2.4	1.25	0.038	0.037	42.51	30.10	0.017	0.015	0.65	0.71
Boron										
B_0	133.41	149.58	3.83	3.91	4061.24	4159.54	0.61	0.58	57.14	58.17
B_1	146.55	154.37	4.18	4.25	4699.79	4799.79	0.75	0.77	56.04	57.00
B_2	148.25	155.56	4.22	4.30	4857.16	4957.83	0.80	0.80	55.10	55.96
S.Ed	0.74	0.55	0.017	0.014	20.71	14.60	0.007	0.006	0.29	0.34
CD (P = 0.05)	1.5	1.11	0.036	0.028	41.64	29.35	0.016	0.014	0.60	0.70

Table 2: Effect of different levels of sulphur and boron on yield attributes and yield of sunflower.

Treatments	Head diameter (cm)		Number of seeds head^{-1}		Number of filled seeds head^{-1}		Seed filling percent		100 seed weight (g)		Seed yield (Kg ha^{-1})		Stalk yield (Kg ha^{-1})	
	I crop	II Crop	I crop	II Crop	I crop	II Crop	I crop	II Crop	I crop	II Crop	I crop	II Crop	I crop	II Crop
Sulphur														
S_0	13.25	15.15	640.33	666.51	504.01	530.13	78.64	79.48	5.54	5.45	1109.39	1209.42	3207.73	3307.39
S_1	15.22	16.58	695.22	722.53	562.00	586.95	80.83	81.24	5.69	5.95	1483.05	1583.08	3402.32	3503.32
S_2	16.27	17.24	787.11	788.20	639.52	648.85	81.91	82.29	5.77	6.07	1707.43	1808.79	3721.85	3764.19
S_3	17.38	18.24	807.33	815.87	665.27	675.19	82.37	82.69	5.99	6.38	2012.27	2111.25	3961.99	4095.31
S_4	17.48	18.63	818.22	847.21	688.14	715.43	84.05	84.42	6.03	6.54	2115.59	2215.95	4180.03	4273.20
S.Ed	0.12	0.12	5.06	7.52	5.11	6.85	0.14	0.17	0.015	0.017	29.10	29.92	17.16	20.59
CD(P = 0.05)	0.25	0.26	10.18	15.12	10.28	13.78	0.30	0.35	0.032	0.036	58.51	60.15	33.26	41.39
Boron														
B_0	14.22	15.76	652.53	666.03	529.69	543.41	81.03	81.48	5.56	5.59	1135.67	1235.02	3257.10	3356.91
B_1	16.72	17.74	792.00	809.05	642.21	662.18	81.32	81.67	5.90	6.29	1919.96	2020.05	3855.24	3970.34
B_2	16.82	18.07	804.40	829.11	663.37	688.35	82.33	82.88	5.94	6.35	2001.00	2102.03	3932.01	4038.80
S.Ed	0.09	0.11	4.78	7.01	4.54	6.18	0.13	0.16	0.014	0.016	25.47	27.91	16.54	20.03
CD (P = 0.05)	0.19	0.24	9.61	14.11	9.14	12.43	0.29	0.34	0.030	0.034	51.21	56.10	33.26	40.28

Yield (Table 2)

Application of S @ 60 kg ha^{-1} recorded maximum seed yield of 2115.59 and 2215.95 kg ha^{-1} and stalk yield of 4180.03 and 4273.20 kg ha^{-1} in first and second crops, respectively. The yield increase might be also due to increased growth, which resulted in increased photosynthesis and assimilation rates, cell division which turn in increased the seed yield. Sulphur application increased the chlorophyll content in leaf gave significant positive correlation between chlorophyll content in leaf crop yield (Sinha *et al.*, 1995).

Boron levels significantly influenced the seed and stalk yield in both the crops. Application of B @ 1 kg ha^{-1} recorded the maximum seed yield of 2001.00 and 2102.03 kg ha^{-1} and stalk yield of 3932.01 and 4038.80 kg ha^{-1} in first and second crop, respectively. This is due to the role of boron in cell division, sugar transport and hormone development (Khalifa, 2005).

The interaction effects between sulphur and boron levels was significant. Application of S_4B_2 (60 kg S ha^{-1} with B @ 1 kg ha^{-1}) recorded higher seed yield (2573.25 and 2673.84 kg ha^{-1}) and stalk yield (4582.73 and 4689.73 kg ha^{-1}) in both the crops. Increased seed yield due to application of sulphur and boron was reported by Sumathi *et al.*, (2005).

References

Asad, A., F.P.C. Balmey and D.G. Edwards (2002). Dry matter production and boron concentrations of vegetative reproductive tissues of canola and sunflower plants grown in nutrient solution. *Plant Soil,* **243:** 243-252.

Asad, A., F.P.C. Balmey and D.G. Edwards (2003). Effect of boron foliar application on veagetative and reproductive growth of sunflower. *Ann. Bot.,* **92:** 565-570.

Belvins, D.G., and K.M. Lukaszewski (1998). Boron in plant structure and function. *Plant Physiol*., **49:** 481-500.

Blamey, F.P.C., R.K. Zollinger and A.A.A Schneiter (1997). In sunflower technology and sunflower production and culture. American Society of Agronomy, Madison, WI, USA, 595-670.

Intodia, S.K. and O.P. Tomar (1997). Effect of sulphur application on growth and yield of sunflower (*Helianthus annuus* L.). *Indian J. Agri. Sci*., **67(1):** 46 -47.

Jamal, A., I.S. Fazli, S.Ahmad, M.Z. Abdin and S.J. Yun (2005). Effect of sulphur and nitrogen application on growth characteristics, seed and oil yield of soybean cultivars. *Korean J. Crop Sci*., **50(5):** 340-345.

Khalifa, R.K.H.M. (2005). Response of peanut to foliar nutrition with some micronutrients. *Egypt. Appl. Sci*., **20(1)**.

Messick, D.L. (2003). Sulphur fertilizers a global perspective, pp 1-7. In: proceeding of TSI-FAI-IFA workshop on sulphur balanced fertilization.

Raja, A., K. Omar Hattab, L. Guruswamy, G. Vembu and K.S. Suganya (2007). Sulphur application on growth and yield and quality of sesame varieties. *Intl. J, Agri. Res*., **2:** 599-606.

Renukadevi, A. and P. Savithri (2003). Sunflower (*Helianthus annuus* L.) oil yield and quality as influenced by boron application. *Madras Agric. J.,* **91:** 74-96.

Sakal, R., A.P. Singh, B.C. Choudhary and B. Shahi (2001). Sulphur status of usifluvents and response of crops to sulphur application. *Fertilizer news,* **46(10):** 61-65.

Sinha, R.B., P. Sakal and S. Kumar (1995). Sulphur and phosphorus nutrition of winter maize in calcareous soil. *J. Ind. Soc. Soil Sci.,* **43(3):** 413-418.

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

Syed, S.H., F.A. Misger, A. Kumar and M.H. Bala (2001). Response of nitrogen and sulphur on biological and economic yield of sunflower (*Helianthus annuus* L.). *Research J. Agric. Sci.,* **2(22):** 308-310.