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Sunflower (*Helianthus annuus*) oil yield and quality as influenced by boron application

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Abstract: A field experiment was conducted at ARS Bhavanisagar, Tamil Nadu Agricultural University in an inceptisol (Typic Ustropet) to evaluate boron fertilizers (borax, boric acid and Agribor) to assess the right mode, level of boron application on the quality of sunflower crop. The experimental soil was deficient in hot water soluble boron (0.35 mg kg^{-1}). Four levels of boron (0.5, 1.0, 1.5, 2.0 kg B ha^{-1}) as soil application and two levels of foliar spray (0.2% and 0.3%) were compared with control. These treatments were super imposed with recommended dose of NPK. The results indicated a concomitant increase in the quality of sunflower with increase in applied boron levels. Soil application of boron at the rate of 2.0 kg ha^{-1} increased the oil content, oil yield and seed protein by 8.1, 22.3 and 25 per cent, respectively over control. On comparing the sources, Agribor having higher solubility in aqueous solution and neutral in reaction, increased the quality of sunflower more than the conventional boron sources. No significant changes were noticed for iodine number, saponification number and acid value of sunflower oil.

Key words : Sunflower quality, Boron nutrition.

Introduction

Sunflower cultivation is gaining importance because its edible oil, contains more of unsaturated fatty acids and is recommended for cardiac patients. However, the yield is not upto the level due to poor seed set and poor filling. In Tamil Nadu, it is cultivated in an area of 0.04 million hectares. But the production is not increasing with increased area. In order to increase the productivity of sunflower crop, balanced fertilization with micronutrient is essential. Among the micronutrients, boron needs special emphasis because it has a marked effect from the stand point of fertilization and seed setting.

Sunflower is one of the most sensitive field crops to low boron supply and deficiency has been reported from all around the world (Blamey *et al.* 1997). Boron is very crucial for carbohydrate and lipid metabolisms and hence the oil content. Research evidences suggest that of boron has a positive and significant effect on oil content. The present study was therefore undertaken to evaluate boron fertilizers and assess the right mode and level of boron fertilizer application for sunflower.

Materials and Methods

A field experiment was conducted at Agricultural Research Station, Tamil Nadu Agricultural University, Bhavanisagar during 1998-99 in an inceptisol (Typic Ustropept) to evaluate the efficacy of Agribor (S_2) which is a boron fertilizer ($Na_2B_{10}O_{16}$. $10H_2O$; pH 6.5-7.5 at 3% solution; 100% soluble; Specific gravity 400 g m^{-3}) in comparison with Borax (soil) and Boric acid (Foliar) (S_1).

The experimental soil was deficient in hot water soluble boron (0.35 mg kg^{-1}). There were seven treatments comprising four levels (T_2-T_5) of B applied basally to the soil (0.5, 1.0, 1.5, 2.0 kg ha^{-1}) and two levels (T_6 and T_7) of foliar spray, besides check (T_1). These treatments were superimposed on recommended dose of NPK. Soil application of B fertilizers was done basally by placement along the furrows before sowing. The foliar sprays were given three times during crop growth. The first spray was given on the 30th day and subsequent two sprays at 10 days interval. Sunflower cultivar Morden was raised as an irrigated crop. The experiment was conducted in factorial randomized block design with three replications. All agronomic practices and plant protection measures were followed as per the recommendation. At maturity the crop was harvested and analysed for oil content and seed protein and quality attributes *viz.* iodine number, saponification number and acid value of sunflower oil were estimated as per the procedure given by A.O.A.C. (1962).

Table 1. Effects of sources, levels and methods of Boron application on sunflower oil content, oil yield and seed protein

Treatment	Oil content (%)			Oil yield (kg ha^{-1})			Seed protein (%)		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_1 - NPK control	35.1	35.3	35.2	576	580	578	13.3	13.6	13.5
T_2 - 0.5 kg B ha^{-1}	35.3	35.4	35.4	604	604	604	13.6	14.0	13.8
T_3 - 1.0 kg B ha^{-1}	35.9	36.8	36.4	647	657	652	14.6	14.7	14.7
T_4 - 1.5 kg B ha^{-1}	37.4	37.7	37.6	691	720	706	15.8	16.5	16.1
T_5 - 2.0 kg B ha^{-1}	38.1	38.5	38.3	730	759	744	17.5	18.4	18.0
T_6 - 0.2% Foliar spray	37.1	37.2	37.2	644	663	654	15.4	16.0	15.7
T_7 - 0.3% Foliar spray	37.1	37.7	37.4	693	703	698	15.6	16.2	15.9
Mean	36.6	36.9		655	669		15.1	15.6	
	T	S	T x S	T	S	T x S	T	S	T x S
SEd	0.221	0.118	0.312	6.53	3.49	9.24	0.114	0.061	0.161
CD (P=0.05)	0.454	0.243	NS	13.43	7.18	18.99	0.234	0.125	0.331

NS : Non significant

Table 2. Effects of sources, levels and methods of B application on quality of sunflower oil

Treatment	Iodine value			Saponification number			Acid value		
	S_1	S_2	Mean	S_1	S_2	Mean	S_1	S_2	Mean
T_1 - NPK control	130.8	130.2	130.5	170.5	170.5	170.5	1.80	1.79	1.80
T_2 - 0.5 kg B ha^{-1}	129.5	129.9	129.7	170.3	170.4	170.3	1.79	1.80	1.80
T_3 - 1.0 kg B ha^{-1}	130.4	130.3	130.3	170.1	170.5	170.3	1.79	1.78	1.79
T_4 - 1.5 kg B ha^{-1}	130.8	130.7	130.7	170.1	170.3	170.2	1.77	1.79	1.78
T_5 - 2.0 kg B ha^{-1}	130.2	130.0	130.1	170.3	170.3	170.3	1.78	1.78	1.78
T_6 - 0.2% Foliar spray	130.3	130.7	130.5	170.3	170.4	170.4	1.80	1.80	1.80
T_7 - 0.3% Foliar spray	130.9	130.3	130.6	170.1	170.2	170.2	1.79	1.79	1.79
Mean	130.4	130.3		170.3	170.3		1.79	1.79	
	T	S	T x S	T	S	T x S	T	S	T x S
SEd	0.392	0.210	0.555	0.117	0.626	0.165	0.008	0.004	0.011
CD (P=0.05)	NS	NS	NS	NS	NS	NS	NS	NS	NS

NS : Non significant

Results and Discussion

The influence of boron on the oil content, oil yield and seed protein are presented in Table 1.

Oil content

The oil content of sunflower seed was increased significantly with the increasing levels of boron added to the soil with the exception of 0.5 kg ha^{-1} (T_2) which was on par with control. The highest oil content (38.3%) was for soil application of boron at the rate 2.0 kg ha^{-1}. The foliar spray of boron at 0.3% (T_7) and 0.2% (T_6) concentration were on par with soil applied boron at the rate of 1.5 kg ha^{-1} (T_4) and was found superior than soil applied boron at the rate of 1.0 kg ha^{-1} (T_3).

Between the two sources tried oil content of seeds was higher for agribor (S_2) than borax (S_1). The enhanced uptake of boron in the seed had a positive and significant effect on the oil content. Similar trends were observed by Survase *et al.* (1986) in groundnut, Chandel *et al.* (1989) in soybean, Ananda Naik *et al.* (1993) in castor and Subbiah and Mitra (1996) in mustard.

Oil yield

Application of boron had brought out a tremendous increase in the oil yield of sunflower. Soil application of 2.0 kg boron ha^{-1} recorded the highest oil yield. The significant increase in oil yield might be due to the increase in oil content following soil application of 2.0 kg boron ha^{-1}.

Seed protein

The result revealed that seed protein was markedly higher (18.0%) for the soil application of boron at the rate of 2.0 kg ha^{-1} as compared to the control (13.5%). Foliar treatments (0.3% and 0.2%) recorded on par values of 15.9 and 15.7 per cent respectively. As compared to control, each treatment was able to bring out a significant increase in the protein content. This might be due to highest uptake of N by seed for boron application and this N might have been subsequently incorporated in the protein molecule. Protein content of seed was significantly higher for agribor compared to borax and boric acid. This is also in accordance with the observations of Ramamoorthy and Sudarsan (1992) on groundnut.

The results revealed that soil application of boron at the rate of 2.0 kg ha^{-1} increased the oil content, oil yield and seed protein by 8.1%, 22.3%, 25.0% respectively over control.

Iodine number, saponification number and acid value

Application of boron either in the soil or to the foliage did not bring any significant change with iodine number, saponification number and acid value of sunflower oil (Table 2). Boron application had no significant effect on the saponification number has also been reported by Asokan and Raj (1974).

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