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INFLUENCE OF BORON SEED TREATMENT ON SEED GERMINATION, SEEDLING LENGTH AND SEEDLING VIGOR IN SUNFLOWER (*Helianthus annuus* L.)

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ABSTRACT
A laboratory experiment was conducted at All India Co-ordinated Research Project on Sunflower, Zonal Agricultural Research Station, University of Agricultural Sciences, Bangalore to investigate the influence of boron seed treatment on seed germination, seedling length and seedling vigor of sunflower (*Helianthus annuus* L.). The experiment was arranged in completely randomized design with three replications. Borax [Sodium tetra borate decahydrate ($Na_2B_4O_7 \cdot 10H_2O$), 11% B] was used as a source of boron. The treatments consist of seed treatment with borax at 0, 2, 4, 6, 8, 10, 15 and 20 gm per kg of seed. Cultivar KBSH-53 was treated according to treatments. After treating, ten seeds were uniformly placed in petri dishes and kept at room temperature (28 ± 2°C). Parameters such as percent germination root and shoot lengths of seedling were recorded and seedling vigor index was calculated. Significantly higher seed germination (100%), root length (5.07cm and 7.27cm respectively), shoot length (7.80cm and 11.47cm respectively) and vigor index (1286 and 1773 respectively) at 7 and 14 days after sowing were recorded in seed treatment with borax at 2 gm per kg of seed over all other treatments and these parameters found to decrease beyond 2g borax per kg of seeds. Significantly lower seed germination (36.67 %), root length (0.60cm and 0.97cm respectively), shoot length (1.60cm and 1.93cm respectively) and vigor index (79.33 and 105.1respectively) at 7 and 14 days after sowing were recorded in seed treatment with borax @ 20 gm per kg of seed treatment.

KEY WORDS: Boron, germination, shoot length, root length, vigor index.

INTRODUCTION

Sunflower (*Helianthus annuus* L.) holds great promise as an oilseed crop because of its short duration, photo insensitivity and wide adaptability to different agro-climatic regions and soil type. Sunflower production is about 37.53 million tonnes from 25.11 million hectares of global coverage with productivity of 1495 kg ha^{-1} (Anon, 2012-13). In India, sunflower is cultivated over an area of about 0.69 million hectares with a production of 0.54 million tonnes and productivity of 791 kg ha^{-1} (Anon, 2014). In India Karnataka, Maharashtra, Andhra Pradesh and Tamil Nadu are the major sunflower growing states. Though the crop has the yield potential of 2.3 to 2.5 tonnes ha^{-1} under favourable conditions, but the average productivity level in India is only 0.79 tonnes ha^{-1}, the productivity of sunflower in India is much lower than the world's average. One of the main reasons for low productivity of sunflower is poor seed setting and high percent of chaffy seeds in the centre of capitulum. The reasons for poor seed setting are self-incompatibility, absence of pollen vectors, nutrient imbalance, less irrigation and low soil fertility. Among these factors, imbalanced nutrition is one of the major causes of low yield of sunflower in the country. Boron is one of the micronutrient required for normal growth and plant development of many crops. Sunflower is one of the most sensitive crops to low boron supply and required high amount of boron as compared to other crops and has been used as a good indicator of boron deficiencies. Soil and foliar applications are the most prevalent methods of micronutrient addition but the cost involved and difficulty in obtaining high quality micronutrient fertilizers are major concerns in developing countries. Seed treatment with boron helps in improving seed germination percentage, shoot length, root length and early seedling vigor hence helps in better early crop growth. The amount of fertilizer required is also less in seed treatment. Being an easy and cost effective method, seed treatment offers alternative option for resource poor farmers. However, the optimum quantity range of boron application is rather narrow, because high concentrations of boron become toxic to plants (Goldberg and Glaubig, 1985). Therefore a laboratory experiment on "Influence of boron seed treatment on seed germination, seedling length and seedling vigor in sunflower (*Helianthus annuus* L.)" was carried out to study the tolerance limit of sunflower to different levels of boron seed treatment.

MATERIALS & METHODS

A laboratory experiment was conducted at All India Co-ordinated Research Project (AICRP) on Sunflower, Zonal Agricultural Research Station, University of Agricultural Sciences, Bangalore to investigate the effect of boron availability on seed germination, seedling length and seedling vigor of sunflower (*Helianthus annuus* L). The experiment was arranged in completely randomized design

with eight treatments replicated thrice *Viz*., T_1: Control (Distilled water soaked seeds), T_2: Borax at 2 gm kg^{-1} seed as seed treatment, T_3: Borax at 4 gm kg^{-1} seed as seed treatment, T_4: Borax at 6 gm kg^{-1} seed as seed treatment, T_5: Borax at 8 gm kg^{-1} seed as seed treatment, T_6: Borax at 10
gm kg^{-1} seed as seed treatment, T_7: Borax at 15 gm kg^{-1} seed as seed treatment, T_8: Borax at 20 gm kg^{-1} seed as seed treatment. Borax [Sodium tetra borate decahydrate ($Na_2B_4O_7 \cdot 10H_2O$), 11% B] was used as a source of boron. Two per cent gum acasia solution was used as adhesive agent to treat the seeds with finely ground borax powder. According to the treatments, manually seeds were treated with the help of 2 per cent gum acasia solution at 10 ml per kg of seed and seeds were allowed to dry for four hours at room temperature. Petri dishes with filter papers were used for sowing of seeds. Filter papers were well soaked by adding distilled water and ten seeds were uniformly placed per Petri dish (9.5 cm diameter) using a forceps. All the petri dishes were covered with lids and kept at room temperature (28 ±2°C). Germination continued for seven days and germinated seeds were counted seven days after sowing. Parameters such as shoot length, root length were recorded using a measuring scale after 7 and 14 days after sowing respectively. Germination percentage and seedling vigor index (SVI) were calculated according to the following formulas.

$$\text{Germination percentage} = \frac{\text{Number of germinated seeds}}{\text{Total Number of seeds kept for germination}} \text{ X } 100$$

Seedling Vigor Index = [Root length (cm) + Shoot length (cm)] x Germination percentage

RESULTS & DISCUSSION

The data on growth observation made on germination, root length, shoot length and vigor index of sunflower following the seed treatment with borax at different levels are presented in Table 1.

TABLE 1: Germination (%), root length (cm), shoot length (cm) and vigor index of sunflower seedling as influenced by different levels of borax seed treatment

Treatments	Germination	7 DAS			14 DAS		
		Root length	Shoot length	Vigour index	Root length	Shoot length	Vigour index
T_1: Control	96.67	3.90	6.16	970.3	5.17	09.77	1442
T_2: Borax at 2 gm kg^{-1} seed as seed treatment	100.0	5.07	7.80	1286	7.27	11.47	1773
T_3: Borax at 4 gm kg^{-1} seed as seed treatment	93.33	3.37	5.93	873.3	5.07	9.10	1319
T_4: Borax at 6 gm kg^{-1}seed as seed treatment	88.33	1.87	5.70	668.5	3.87	7.67	1019
T_5: Borax at 8 gm kg^{-1} seed as seed treatment	85.00	1.47	4.67	522.5	3.37	6.70	856.1
T_6: Borax at 10 gm kg^{-1} seed as seed treatment	80.00	1.30	3.90	416.0	2.63	5.47	648.0
T_7: Borax at 15 gm kg^{-1} seed as seed treatment	63.33	0.87	2.94	241.3	1.42	3.57	315.0
T_8: Borax at 20 gm kg^{-1} seed as seed treatment	36.67	0.60	1.60	79.33	0.97	1.93	105.1
S.Em±	3.54	0.31	0.29	60.43	0.31	0.45	60.93
CD (p= 0.01)	10.72	0.93	0.88	179.9	0.94	1.34	181.0
CV (%)	5.20	4.30	4.60	4.10	5.00	3.60	4.30

Germination percentage

Laboratory studies (Table-1) indicated that the treatments affected the seed germination significantly. Seed treatment with borax at 2 gm kg^{-1} of seed recorded significantly higher seed germination (100 %), which was on par with control (96.67 %) and seed treatment with borax at 4 gm kg^{-1} of seed (93.33 %). A significant decrease in germination percentage was observed as boron concentrations increased beyond 4 g kg^{-1} of seed. Significantly lower germination (36.67 %) was recorded in seed treatment with borax at 20 gm kg^{-1} of seed followed by seed treatment with borax at 15 gm kg^{-1} of seed (63.33 %) which was mainly due to boron at higher concentration inhibits the germination (Brown *et al*., 2002).

Root length (cm)

At 7and 14 days after sowing (Table 1) seed treatment with borax at 2 gm $kg^{-1}$of seed recorded significantly higher root length (5.07 cm and 7.27 cm, respectively) compared to other treatments. This was mainly due to boron plays a major role in cell division and cell elongation resulted in rapid multiplication of root cells, resulted in increased root growth. The results are in conformity with Khan *et al*. (2006)**.** However, the root length decreased significantly with the increase in borax concentration beyond 2 gm kg^{-1} of seed. The lowest root length (0.60 cm and 0.87 cm, respectively) at 7 and 14 days after sowing was recorded in seed treatment with borax at 20 gm kg^{-1} of seed. The decrease in root length was mainly due to boron at higher levels inhibits root growth primarily through limiting cell elongation and cell division and resulted in decreased root length (Brown *et al*., 2002).

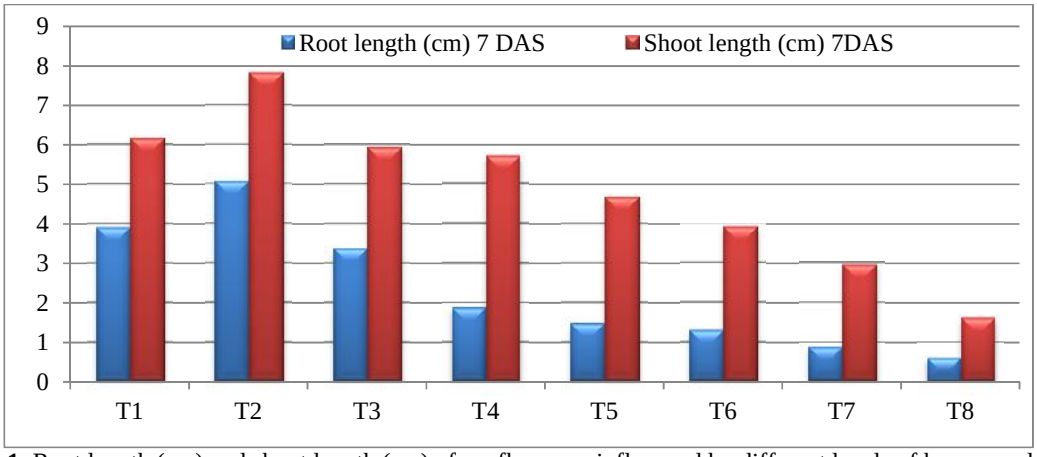

FIGURE 1: Root length (cm) and shoot length (cm) of sunflower as influenced by different levels of boron seed treatment (7 days after sowing)

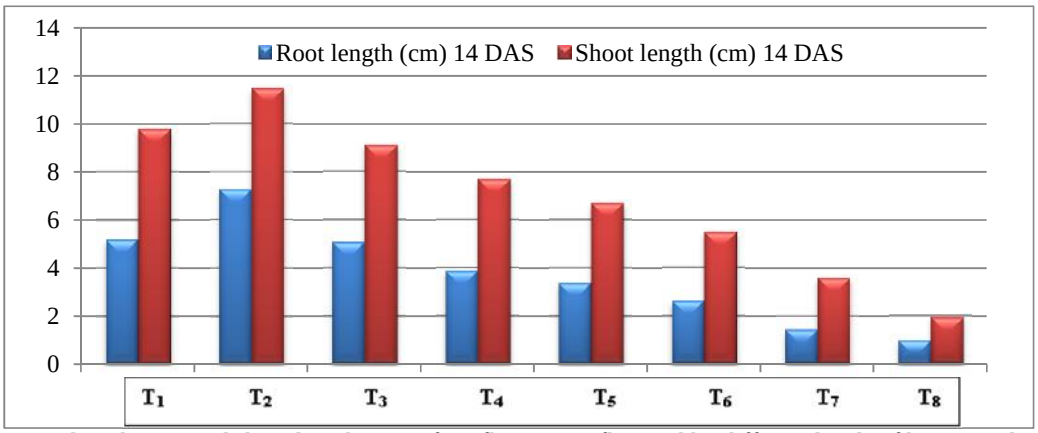

FIGURE 2: Root length (cm) and shoot length (cm) of sunflower as influenced by different levels of boron seed treatment (14days after sowing**)**

Shoot length (cm)

The data revealed that there was a significant difference with respect to shoot length at 7 and 14 days after sowing as influenced by different levels of borax seed treatment (Table 1). Seed treatment with borax at 2 gm $kg^{-1}$of seed recorded significantly higher shoot length (7.80 cm and 11.47 cm, respectively) at 7and 14 days after sowing compared to other treatments. This was mainly due to boron role in cell division and cell elongation which increases shoot growth. The results are in conformity with Khan *et al*. (2006)**.** However, shoot length decreased significantly with the increase in borax concentration beyond 2 gm kg^{-1} of seed. The lowest shoot length (1.60 cm and 1.93 cm, respectively) was recorded in seed treatment with borax at 20 gm kg^{-1} of seed. The decrease in shoot length was mainly due to the fact that boron at higher levels inhibits cell elongation and cell division and resulted in decreased shoot length (Brown *et al*., 2002).

Vigor index

Seed treatment with borax at different levels showed a significant influence on seedling vigor index. The maximum seedling vigor index was recorded in seed treatment with borax at 2 gm kg^{-1}seed at 7 and 14 days after sowing (1286.7 and 1773.3 $plant^{-1}$, respectively) (Table 1), which was significantly higher over all other treatments. This was mainly due to boron at lower levels plays a role in cell division and cell elongation and resulted in increased germination percentage, root length and shoot length of sunflower seedlings. Similar results were also reported by Habtamu Ashagre *et al*. (2014).The seedling vigor index tended to decrease at higher levels of borax. Significantly lower seedling vigor index was recorded at seed treatment with borax at 20 gm kg^{-1} seed (79.33 and 105.1 $plant^{-1}$ respectively) at 7 and 14 days after sowing. The decreased vigor index was mainly due to the fact that phytotoxicity of shoot and root increased with an increase in boron concentration which reduces root and shoot length which in turn resulted in lesser vigor index (Habtamu Ashagre *et al*., 2014).

CONCLUSION

The results of this laboratory study indicated that the seed treatment with borax at 2 gm kg^{-1} of seed helps in improving germination percentage, root length, shoot length and early seedling vigor hence resulted in better early crop growth. Being an easy and cost effective method, seed treatment offers alternative option for resource poor farmers. And seed treatment at higher boron concentrations, showed deleterious effect on germination and seedling growth and seedling vigor of sunflower, Hence optimum level of boron seed treatment is necessary to get high germination per cent and better early crop growth in sunflower. Further research is required under field conditions to determine the influence of boron seed treatment on seed germination and initial crop in sunflower and efficacy of seed treatment along

with spraying of borax to capitulum at ray floret opening stage is required.

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