ISSN NO. 2320-5407

Journal homepage: http://www.journalijar.com

INTERNATIONAL JOURNAL OF ADVANCED RESEARCH

RESEARCH ARTICLE

EFFECT OF BORON ON GERMINATION PERFORMANCE IN DIFFERENT VARIETIES OF SWEET *SORGHUM*

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Manuscript Info

Manuscript History:

Received: 12 February 2014
Final Accepted: 14 March 2014
Published Online: April 2014

Key words:
Sweet *Sorghum*, Boron, concentrations, germination percentage, root and shoot length.

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Abstract

The sweet *Sorghum* c. v. Madhura, SSV-84and RSSV-9 were selected for the present investigation. The sterilized seeds of these varieties were germinated in laboratory in different concentrations of boron i.e. 5 ppm, 10 ppm, 50 ppm, 100 ppm and 200 ppm up to 120 hrs. The parameters like germination percentage root and shoot length, fresh and dry weight were analyzed. Germination percentage in all varieties is reduced in the initial stages but recovered in later stage of germination except in 200 ppm boron concentration treatment. The variety SSV-84 shows inconsistency in germination pattern as compare to Madhura and RSSV -9 varieties. The root length increased in Madhura and RSSV-9 at low boron concentrations i. e. at 5 ppm and 10 ppm as compare to higher concentrations of boron. Similar response was also noticed to shoot length in all varieties under the investigation. A noticeable increase in fresh weight with lower concentration of boron in all varieties was observed. However no change in dry weight except variety SSV-84 at 120 hrs. was recorded under boron treatment.

Introduction :-

The sweet *Sorghum*(*Sorghum bicolor*, L) is an important world crop used for food , fodder, the production of alcoholic beverages as well as bio fuel like ethanol .(Ratnavathi et al. 2004).India is among the major producer country of *Sorghum* in the world. The world average area under cultivation of *Sorghum* production sums around 4, 40,000 sq. km.

Boron is one of the most important micronutrient for plant growth and plays an important role in the physiological processes within plant. (Warrington, 1923) Boron in soil and irrigation water is an important determinant of agricultural production. In arid and semiarid regions with high boron ground water, where the accumulation of boron in the top soil is high, due to the evaporation of ground water having boron which reaches to the toxic levels which ultimately reduces crop yields. (Tanaka and Fujiwara, 2007).

Several attempts have been made to study the effect of various growth regulators on performance of *Sorghum* plants. However literature of effect of boron on physiology of *Sorghum* is scanty.

In the present investigation, an attempt will be made to study the impact of boron on seed germination and its physiology such as germination, root and shoot length, fresh and dry biomass.

Material and Methods :-

The seeds of different cultivars of *Sorghum bicolor* (c.v. RSSV-9, SSV-84 and Madhura)were analyzed for the present investigation. The seeds were collected, washed in distilled water and sterilized with 0.1 % HgCl2 for two min. and washed with sterile distilled water. The twenty seeds of every variety were germinated with various concentrations of boron such as 5 ppm, 10 ppm, 50 ppm, 100ppm and 200 ppm along with control in sterile distilled water and these seeds were kept in dark for overnight and first observation is taken after 24 hrs. This is

recorded for successively with five intervals up to 120 hrs. The observations were noted down time to time for the different parameters like germination percentage, root and shoot length, fresh and dry weight.

Results and Discussion:-

Fig. 1 shows effect of various conc. of boron on germination percentage in different varieties of sweet *Sorghum* var. Madhura, SSV-84, RSSV – 9

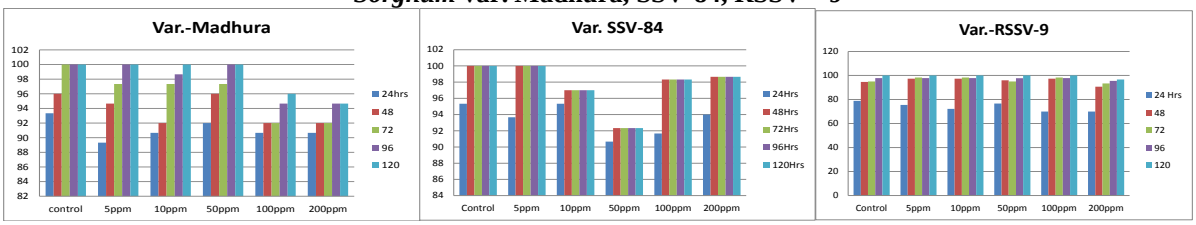

Fig.1

The initial reduction in germination recovered after 96 hrs.due to only low concentrations of boron is reported in c.v. Madhura and RSSV-9. But c.v. SSV-84 was found to be sensitive to boron shows reduction in germination percentage even after 10 ppm boron treatment.

The effect of boron on germination performance of crop plants has been studied by very few workers. The varietal differences in different cultivars of pigeon pea and cow pea germination performance with respect to boron toxicity were reported by Paliwal (1973). Kunjeyamma(1983) reported retardation of germination in rage varieties. The low boron concentration of boric acid caused improvement of germinability of pigeon pea seeds.(Basu et al 1975).25g boron per 100kg.of seeds increased germination and seedling growth in wheat(Danchinov 1970). A reduced germination percentage was also registered for treatment of sweet pepper (*Capsicum annum*) when higher doses of micronutrients were used for seed priming.(Diniz et al 2009). Boron is responsible for breaking dormancy in *Themeda triandra* Forsk, as well as stimulates germination process.(Cresswell and Nelson 1971).

The high rate of boron reduces the rate of germination in flax seeds was reported by Jensen(1951).The significant reduction in germination rate in barley was reported by Ajouri et al (2004). In maize seeds, germination percentage was not affected at low boron concentration i. e. up to 10 mM.but decreased at high boron concentration i. e. by 20Mm. Recently Mirshekari (2012) reported in *Anthum graveolens* the germination percentage increases after 10 days due to low concentration of boron.

Our results are in agreement with earlier reports but differential varietal response to boron was also noticed in present investigation.

Fig. 2shows the effect of various concentrations of boron on root length in different varieties of sweet *Sorghum*.

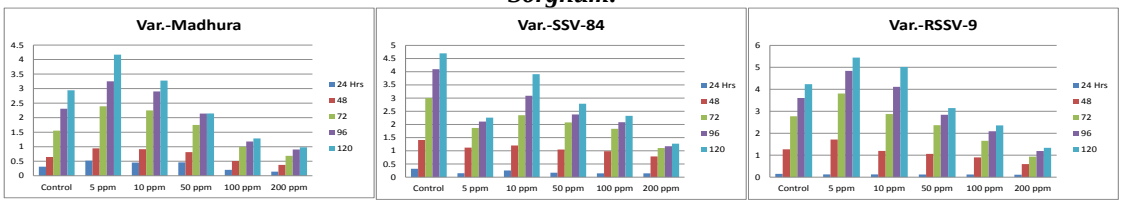

Fig.2

The c.v. Madhura and RSSV-9 shows highest root growth at low concentrations of boron at every stage of interval over control. But root growth has retarded due to higher concentration of boron i.e. at 100 ppm and 200 ppm concentration in all cultivars under investigation.

Mohsin Konuk et al (2007) in *Allium cepa* found increased root growth up to 50 ppm concentration. A decrease in root length was noticed at doses of 100 ppm and above concentration treatments. They found dark colored, more thick and gel like root formation at and above 100 ppm concentration of boron. Boron toxicity shows marked adverse effect on seedling growth rather than the germination percentage. Paliwal and Mehta (1973) in paddy varieties found that the germination percentage was unaffected at 40 ppm boron, but the seedling growth even inhibited by 5 ppm boron. In plants like sunflower and tomato given 0 to 60gms B/gms treatment for 3 weeks and found that root length is unchanged in sunflower but decreased 38 % in tomato at high concentration of boron (Yuksel et al 2011)

The lower boron concentrations stimulate root growth as compare to higher concentration treatments in Sorghum varieties noticed in present investigation.

Fig. 3 Shows effect of various concentration of boron on shoot length in different varieties of sweet *Sorghum*.

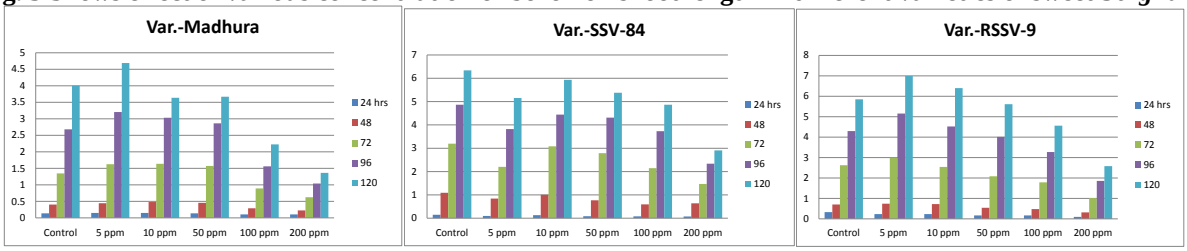

Fig.-3

The c.v. Madhura and RSSV-9 at low concentration of boron i.e. at 5 ppm shows better shoot growth. The c.v. SSV-84 shows decreased shoot growth due to all concentrations of boron applied. But in all varieties reduced shoot growth due to higher boron concentrations.

Rerkasem et al (1997) observed a normal seedling growth of soybean c.v. NW1 in response to boron concentration up to 14-20 mg/ kg. Bhamburdekar (2002) in Pigeon pea cultivar ICPL-87 found sensitivity to boron toxicity, in particular 100 ppm boron is highly inhibitory for shoot growth in the seedling of this species. Haby et al (1923) and Smith et al (1993) reported significant increase in the clover shoot growth when boron was applied to an acidic soil from Texas. Rerkasem and Jamjod (2004) in wheat found that in sand culture with different concentration of boron and reported that high root and shoot growth at low boron concentration. Yuksel et al (2011) in plants like sunflower and tomato planted in pot treated with 0,20,40,60 gms. B/gms for 3 weeks and found that shoot length was decreased by 28% in sunflower and by 43% in tomato seedlings at 60 g /B gms. Our results are in agreement with previous findings i.e. low concentration of boron stimulates root growth.

Table 4 Shows effect of various concentration of boron on fresh weight in different varieties of sweet *Sorghum*.

Treatments	Fresh weight in Gms.														
	24Hrs			48Hrs			72 Hrs			96 Hrs			120 Hrs		
	Madhura	SSV-84	RSSV-9	Madhura	SSV-84	RSSV-9	Madhura	SSV-84	RSSV-9	Madhura	SSV-84	RSSV-9	Madhura	SSV-84	RSSV-9
Control	0.054	0.056	0.0525	0.065	0.0666	0.0609	0.0679	0.0747	0.0685	0.068	0.1767	0.0986	0.094	0.2397	0.188
5ppm	0.055	0.0554	0.052	0.062	0.0737	0.0629	0.0668	0.0846	0.0686	0.0689	0.1734	0.0902	0.1028	0.2489	0.188
10ppm	0.053	0.0558	0.0498	0.067	0.0666	0.0562	0.0741	0.0765	0.0711	0.0792	0.1783	0.1288	0.1159	0.2457	0.192
50ppm	0.057	0.0572	0.0502	0.063	0.0704	0.0594	0.0676	0.088	0.0703	0.071	0.1454	0.125	0.1028	0.1888	0.165
100ppm	0.052	0.0576	0.0494	0.063	0.0662	0.0578	0.065	0.0731	0.0606	0.0667	0.1128	0.0904	0.0798	0.1586	0.133
200ppm	0.052	0.0598	0.0491	0.063	0.0649	0.0548	0.0668	0.0688	0.06	0.0674	0.0858	0.0734	0.0742	0.1126	0.104

Table - 4

The fresh weight results are consistent as they show similarity in all the three varieties. All varieties of *Sorghum* under investigation i. e. Madhura,RSSV-9 and SSV-84 shows increased fresh weight at the low boron concentration i. e. at 5 ppm and 10 ppm. But higher boron treatment from 50 ppm to 200 ppm reduced fresh weight during the course of germination.

Bhamburdekar (2002) in Pigeon pea reported that higher boron concentration adversely affected fresh weight biomass than lower boron concentration in shoot growth. Tariq and Mott (2006) get maximum yield of both shoot and roots from the treatment relieving 0.5 mg B/lit. Followed by 0.25 mg B /lit. But no significant difference was found between yields of these two treatments indicating a narrow range for B sufficiency. Scripture and Mchargue (1945) between 0.25 and 0.5 mg B /lit. in sand culture study found that treatment received 0.5 mg B /lit. seems to be an optimum level of soluble boron for radish which shows best growth response.

In the present investigation the increase in fresh weight due to low boron concentrations may be due to increase in water uptake.

Table 5 shows effect of concentration of boron on the dry weight in different varieties of sweet *Sorghum*.

Treatments	Dry weight in Gms.														
	24Hrs			48Hrs			72 Hrs			96 Hrs			120 Hrs		
	Madhura	SSV-84	RSSV-9	Madhura	SSV-84	RSSV-9	Madhura	SSV-84	RSSV-9	Madhura	SSV-84	RSSV-9	Madhura	SSV-84	RSSV-9
Control	0.0386	0.0362	0.0357	0.0402	0.035	0.0329	0.0381	0.0351	0.0308	0.0367	0.0378	0.0302	0.0354	0.276	0.0266
5ppm	0.0394	0.0348	0.0334	0.0374	0.0359	0.0324	0.0376	0.036	0.0312	0.0338	0.0342	0.0278	0.0354	0.283	0.0278
10ppm	0.0362	0.0354	0.0261	0.0393	0.0357	0.0314	0.0379	0.0349	0.0323	0.0358	0.0358	0.0304	0.0313	0.29	0.276
50ppm	0.0389	0.037	0.0331	0.0388	0.0365	0.0334	0.0360	0.0353	0.0313	0.0376	0.0336	0.0288	0.0362	0.0307	0.0288
100ppm	0.0402	0.03363	0.0331	0.0391	0.0355	0.0339	0.0379	0.0338	0.0321	0.0358	0.0365	0.0299	0.0335	0.0338	0.0286
200ppm	0.0366	0.0364	0.0329	0.0412	0.0378	0.0336	0.0372	0.037	0.0314	0.0363	0.0351	0.0298	0.0363	0.0334	0.0297

Table 5

Madhura and RSSV-9 shows less dry weight at 200 ppm boron concentration as compare to low boron treatments. But var. SSV -84 shows less consistent results.

Dry weight increased when boron applied in Al containing soil was noticed by Noble et al (1996). Dry weight matter increased in acidic soil in Brazil with boron treatment. (Favaretto et al 2007). But Rosario (1963) reported the differentiated response in increased and decreased dry weight at two different places in some bean plant due to boron application.

Our results show some inconsistency in dry weight was noticed.

Conclusion -:

From the present investigation it has been observed that higher concentrations of boron i. e. 200 ppm, adversely affect germination in all varieties of Sweet .

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