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Response of Sunflower Hybrid APSH 66 to Sulphur and Borax Under Varying Environments in Semi Arid Conditions

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ABSTRACT

A field experiment to study the response of sunflower hybrid APSH 66 to sulphur and borax was conducted on red chalka soils of Seed Research and Technology Centre, Rajendranagar, Hyderabad during 2010-11, 2012-13 and 2013-14. The soil had 161.8 kg N, 32.4 kg P_2O_5 and 267.1 kg K_2O in available forms. Sulphur and Borax were tested in nine treatments to study their influence on seed yield by also taking into account the weather variables simultaneously. The results revealed that soil application of sulphur @ 10 kg ha^{-1} and borax @ 1 kg ha^{-1} significantly increased the sunflower yield by 14.5% and 11.64%, respectively over control. Interestingly, rise in average night temperatures by 1.1 degrees centigrade during reproductive phase favored ultimate sunflower seed yield.

Key words: *Borax, Seded yield, Sunflower, Sulphur, Weather.*

Sunflower is a photo insensitive crop can be grown throughout the year. The area is dramatically decreasing due to several reasons like improper seed filling, low seed yield and non availability of the parental seed for quality seed production. Apart from climatic conditions, nutrients available for growth and development may influence the overall plant structure and yield. Spray of micronutrients in very small quantities play an important role in overcoming these problems. Micronutrients enhance the crop growth, improve the crop quality and impart resistance to biotic and abiotic stresses. Among the micronutrients, sulphur and boron are very important.

Sulphur is an important component of the amino acids, cystin, cystein and methionine, and is needed for chlorophyll formation. Also plays an important role in the chemical composition of seeds and is required for protein and oil synthesis. Improves the quality of the produce due to its vital role in several enzymatic processes. Boron play role in cell division, water relations, ion absorption, IAA and carbohydrates metabolism, translocation of sugars, fruit and seed development and its deficiency may affect all these processes. Boron is necessary for increased reproduction, pollen germination, pollen availability, enhances fertilization and improves stigma receptivity and seed setting.

Sunflower is grown in pre and post monsoon seasons in Andhra Pradesh. The sowings, fertilizers and micronutrient management shall be planned in such a way that maturity of the crop doesn't coincide with rains, since rains during maturity period adversely affects the seed quality.

MATERIAL AND METHODS

The weather data pertaining to different weather parameters during the crop growing season were recorded from the agro meteorological observatory located in the university campus close to the site of the field experiment. Observations on air and soil temperatures, relative humidity, open pan evaporation, canopy temperature and albedo were measured in addition to plant phenology, phenophases, yield and yield components. The crop was exposed to weather as it existed during all the three years. The field was kept fallow to reduce error due to treatments prior to the crop sowings, in all the three years *viz*., 2010-11, 2012-13 and 2013-14 of field studies. The design of the experiment was RBD and the gross and net plot sizes were 6.0 m x 4.5 m and 5.4 m x 3.6 m, respectively. The sowings were taken up after field preparation as per the standard recommendations. The lay out was done, in such a way that the treatments were allotted at random to different plots of each replication.

Table 1. Influence of Sulphur and boron on yield and yield attributing characters of the seed parent of sunflower hybrid, APSH 66.

Treatments	Seed setting %				Seed yield (q ha^{-1})				Test weight (g)			
	2010-11	2012-13	2013-14	MEAN	2010-11	2012-13	2013-14	MEAN	2010-11	2012-13	2013-14	MEAN
Soil application of sulphur @ 10 kg /ha	68.0	81.1	78.97	76.0	11.40	11.27	10.56	11.08	4.66	4.64	4.71	4.67
Soil application of sulphur @ 20 kg /ha	61.0	84.3	73.41	72.9	10.70	9.89	9.59	10.06	4.65	4.28	4.51	4.48
Soil application of sulphur @ 30 kg/ha	57.0	79.3	70.82	69.0	10.37	10.07	9.66	10.03	4.96	4.01	4.59	4.52
Soil application of borax @ 0.5 kg /ha	74.0	80.4	75.79	76.7	9.97	9.99	9.62	9.86	4.9	4.84	4.75	4.83
Soil application of borax @ 1.0 kg/ha	60.0	79.7	77.34	72.3	10.97	10.65	10.22	10.61	5.27	4.84	4.76	4.96
Soil application of borax @ 1.5 kg/ha	59.0	80.3	70.1	69.8	9.83	10.33	9.82	9.99	4.45	4.36	4.78	4.53
Dusting of boron @ 2 kg /ha on flower heads	65.0	76.3	69.47	70.3	9.47	9.9	9.55	9.64	5.22	5.19	4.88	5.10
Directed spray of boron on flower head @ 0.2%	59.0	71.7	70.94	67.2	10.20	8.2	9.74	9.38	5.28	4.85	4.66	4.93
Control (unsprayed / no soil application)	60.0	70.8	67.81	66.2	9.13	6.78	9.03	8.31	4.76	4.88	4.82	4.82
Gr. Mean	62.4	78.21	72.75	71.1	10.23	10.04	9.75	9.89	4.9	4.65	4.72	4.76
S.Em.	3.93	2.77	3.59	2.02		0.56	0.13	0.36	0.26	0.22	0.25	0.13
C.D.	11.45	8.31	10.45	6.07		1.67	0.38	1.07	0.75	0.66	0.71	0.38
C.V. (%)	12.6	6.14	9.87	4.92		10	12.94	6.25	10.54	8.15	10.38	4.59

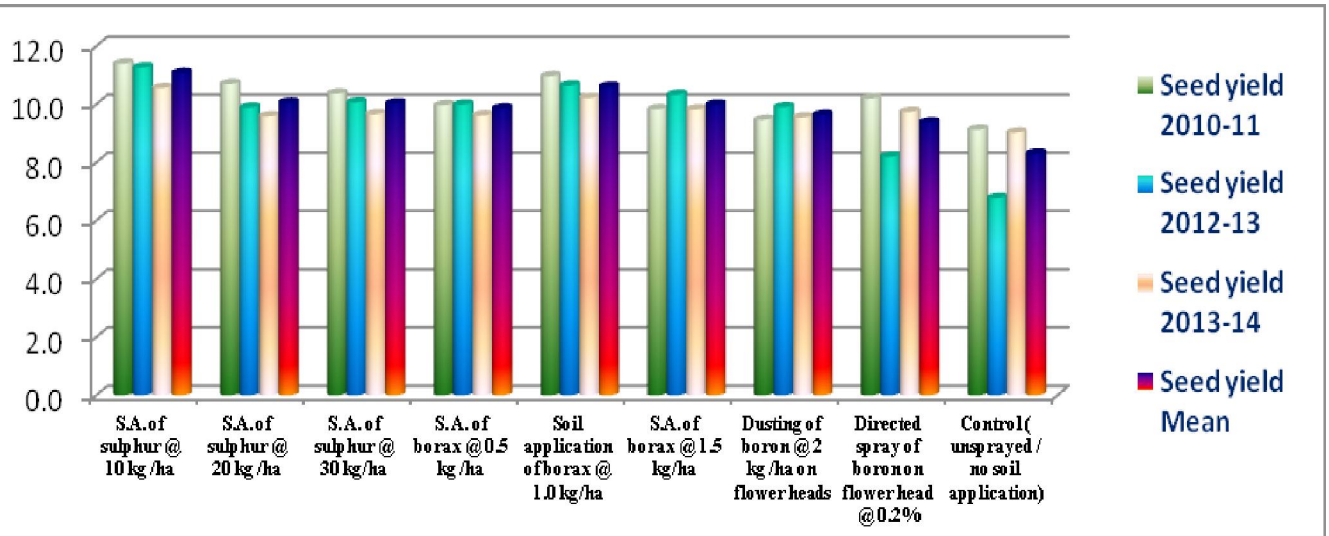
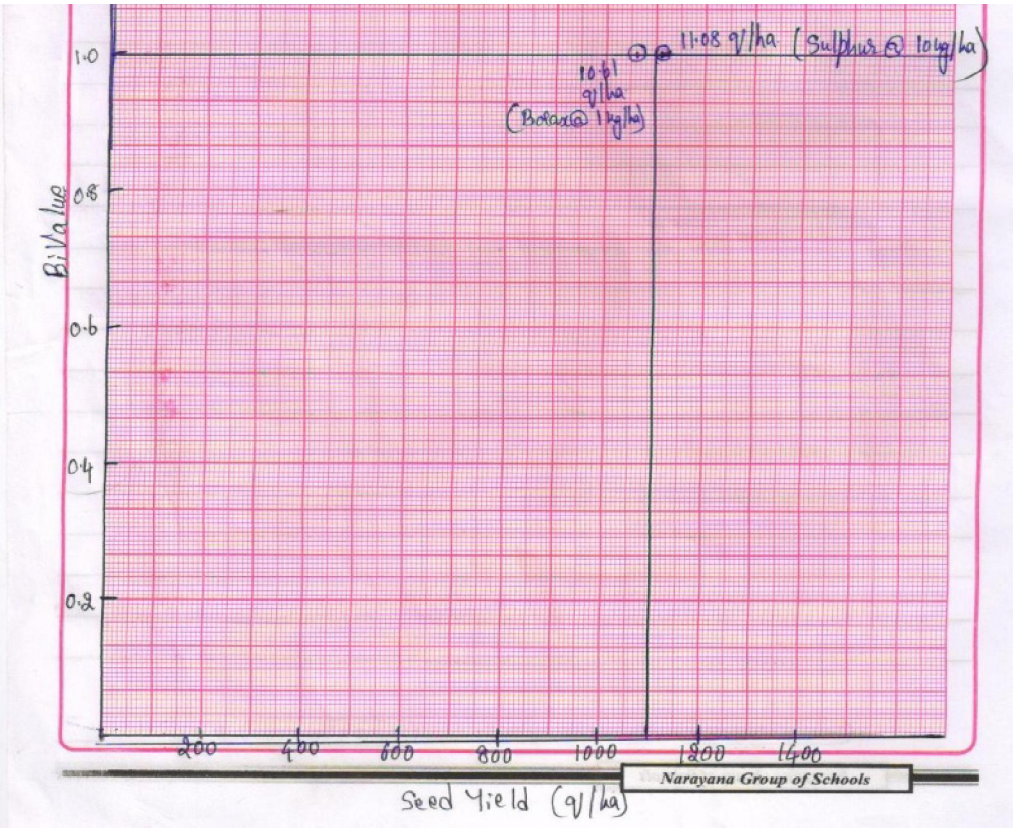


Fig. 1. Seed Yield (q/ha) as Influenced by Application of Sulphur and Boron in Seed Production Sunflower Hybrid, APSH 66.

Table 2. Influence of Sulphur and Boron on seed quality parameters of sunflower hybrid, APSH 66.

Treatments	Germination (%)				Seedling vigour index I			
	2010-11	2012-13	2013-14	Mean	2010-11	2012-13	2013-14	Mean
Soil application of sulphur @ 10 kg /ha	100	90	91	93.7	2634	1655	2566	2285
Soil application of sulphur @ 20 kg /ha	100	78	88	88.7	2649	1453	2350	2151
Soil application of sulphur @ 30 kg/ha	100	79	89	89.3	2420	1223	2501	2048
Soil application of borax @ 0.5 kg /ha	100	78	88	88.7	2819	1527	2367	2238
Soil application of borax @ 1.0 kg/ha	100	83	93	92.0	2695	1572	2418	2228
Soil application of borax @ 1.5 kg/ha	100	82	82	88.0	2617	1369	2328	2105
Dusting of boron @ 2 kg /ha on flower heads	100	84	86	90.0	2770	1110	2305	2062
Directed spray of boron on flower head @0.2%	100	82	82	88.0	2687	1320	2280	2096
Control (unsprayed / no soil application)	100	67	81	82.7	2649	982	2260	1964
Gr. Mean	99.96	80.4	87.41	89.3	2660	1356.7	2412.58	2143
S.Em.	0.06	4.4	6.56	2.2	158.1	174.8	209.81	81.45
C.D.	0.18	13.1	19.67	6.58	460.5	524	628.94	244.2
C.V. (%)	0.12	9.4	13	4.27	11.9	22.3	15.06	6.62

Fig. 2. Stability parameters for seed yield of sunflower hybrid, APSH 66 with soil application of boron @ 10 kg ha^{-1} and soil application of borax @ 1 kg ha^{-1}.



RESULTS AND DISCUSSION

Nine treatments *viz*., soil application of sulphur @ 10 kg ha^{-1}, 20 kg ha^{-1} and 30 kg ha^{-1}; soil application of borax @ 0.5 kg ha^{-1}, 1 kg ha^{-1} and 1.5 kg ha^{-1}; dusting of borax @ 2 kg ha^{-1} on flower heads at the time of ray floret initiation and direct spray of boron on flower heads @ 0.20% were imposed besides maintaining a control plot. The results revealed that soil application of sulphur @ 10 kg ha^{-1} and borax @ 1 kg ha^{-1} significantly increased the sunflower yield by 14.5% and 11.64% respectively over control (Table 1 and Fig. 1). Basal soil application of sulphur and borax, dusting of boron at ray floret opening and direct spray of boron on flower head resulted in significant improvement in seed setting per cent (67.2 to 76.7) as compared to control (66.2). The per cent improvement in seed setting with direct spray of boron on flower head was 1.51% higher than control, while soil application of sulphur @ 10 kg ha^{-1} resulted in 76.0% setting *i.e.,* 14.80% improvement over control. The increase in seed setting percentage significantly contributed to increased seed yield. This shows that sulphur played an important role in enhancing the growth of the plant, thereby increasing seed setting percentage and seed yield. Further soil application of sulphur @ 10 kg ha^{-1} and borax @ 1 kg ha^{-1} were found superior for seed quality parameters like germination and seedling vigour index I (Table 2). Sulphur @ 10 kg ha^{-1} resulted in 94% germination with a seedling vigour index of 2285 and was on par with application of borax @ 1 kg ha^{-1} which resulted in 92 per cent germination and 2228 seedling vigour indicating that sulphur improves the quality of the harvested produce due its role in several enzymatic processes.

Fluctuations in weather during vegetative phase of the crop, due to annual variations in all the three years, had little influence on crop growth but had significant effect at reproductive phase. There were significant differences in the time taken for the transformation of the morphological expressions into different phenophases due to treatments. Both soil and air temperatures affected the plant height while growth was inversely related to difference in canopy and air temperatures. It was also found that the effects of night temperature on growth of sunflower were significant. As the night temperature during the reproductive phase increased from 21.3 to 22.2ºC the yield increased, indicating a strong thermo sensitive response of the hybrid APSH 66 tested. The weather variables had a significant impact on the yield components and yield of sunflower hybrid, APSH 66 in different treatments.

Paroda and Hynes (1971) reported that the linear regression measures the response of a particular genotype, while the deviation from regression is most suitable to measure stability. The phenotypic stability of a genotype is measured by adopting three parameters *viz*., mean performance of a genotype in different environments, its linear regression on environmental index and the standard deviation. The lower the deviation, the more stable is the genotype. Considering these proposals both the treatments *viz.*, sulphur @ 10 kg ha^{-1} and borax @ 1 kg ha^{-1} found to be highly responsive to favorable environment. The regression coefficient was 0.92 for sulphur @ 10 kg ha^{-1} and 1.09 for borax @ 1 kg ha^{-1}. The standard deviations were negative and highly significant for both the treatments, confirming the findings of Ghosh *et. al.* (2014) that a moderate increase in the night temperatures during the reproductive phase significantly increases the yield of any tropical crop under semi arid conditions (Fig.2).

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