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Effect of sulphur on seed yield and oil content in safflower

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ABSTRACT

The experiment was carried in District Seed Farm 'D' Block, Kalyani, Nadia with four varieties of safflower and four different treatments in four replication in split-plot design. The four treatments were: application of sulphur @ 20,40 and 60kg sulphu. ha^{-1} along with control i.e., without application of sulphur. Among the treatments application of sulphur @ 20 kg.ha^{-1} and 40 kg.ha^{-1} was found most effective for increment of seed yield and oil yield respectively for safflower.

Key words: Biological yield, oil content and sulphur application

Among the minor oil seed crops in India safflower (*Carthamus tinctorious*) is one of the most important crop owing to its various use and special qualities. The crop is being cultivated for centuries in India either for its orange-red dye extracted from its brilliantly coloured florets and/or for its much-valued oil; but the crop is now grown mainly for edible oil extracted from seed. Seeds of safflower contain 24-36% oil (Singh, 1983). Sulphur is now recognized as the fourth major nutrient next to nitrogen, phosphorus and potash. It plays a vital role in formation of chlorophyll, activation of enzymes and improvement in both crop yield and oil yield (Tandon, 1995). Keeping in view the importance of sulphur(S), the field experiment was conducted for consecutive two years on varying response of four safflower varieties towards sulphur application for both seed and oil yield.

MATERIALS AND METHODS

The present study was conducted during *rabi* season of 2006-07 and 2007-08 in District Seed Farm 'D' Block,Kalyani and in the Department of Seed Science and Technology, Bidhan Chandra Krishi Viswavidyalaya, Mohanpur, Nadia, West Bengal. Provide lat-long and other conditions of the experimental site. The experiment was carried out with four different varieties of safflower viz., A1, A200, A300 and Bhima. Before flowering, three different doses of sulphur: viz, 20 (T_1), 40 kg.ha-1 (T_2) and 60 kg.ha-1 (T_3) follow journal style in form of gypsum was applied on the root zone of the crop and incorporated into the soil to assess the effect of sulphur. The experiment was carried out in split plot design with four replications placing the varieties in the main plot and treatments in the sub-plot. Number of treatments within each sub-plot were four (including control T_0, without S-application) and there were five rows of five(5) meters length for each treatment leaving one row gap/blank between two consecutive treatments. After harvesting seed yield g.plant^{-1} was recorded and oil content of produced seeds were estimated following the method described by Sadasivam and Manickam (1992).

RESULTS AND DISCUSSION

Average seed yield per plant was consistently high for A200 irrespective of the years and pooled condition followed by A300, A1 and Bhima. performance of A_{300}, A1 and Bhima were noted to be statistically at par with each other in the first year and pooled condition while it were A1 and Bhima in second year. Comparatively better performance of all the varieties in first year may be due to the better potential expression of component characters subjecting to favourable climatic conditions. Maximum seeds yield per plant was recorded after application of S @ 20 kg.ha^{-1}, when average was made over varieties, though it was statistically at par with application of S @ 60 kg.ha^{-1} over the years. It is to be noted that S-application @ 40 kg .ha^{-1} could not be able to influence in enhancing seeds yield over control. Therefore, economic consideration of seed production may suggest to recommend pre-flowering application of S @ 20 kg.ha^{-1} provided other factors remain unaffected. While considering the interaction effects, highest magnitude in seed yield per plant could be observed after A200 when sulphur was applied with 40 kg.ha^{-1} (T_2) in first year and pooled condition, while it was A300 in second year when applied with 60 kg S.ha^{-1} (T_3). Response of individual varieties towards application of sulphur with varying doses can be noted in different manner: A_{200} is the only variety for which no significant response could be recorded over the years, significantly best response towards 20 kg sulphur.ha^{-1} was recorded for A_1, significantly similar positive response towards both 20 kg and 60 kg sulphur.ha^{-1} was noted for A_{300}, while Bhima responded best after 60 kg sulphur.ha^{-1},which indicated the existence of variety-specific response in enhancing for production of seeds per plant. Significant influence of sulphur on yield and yield attributes in Safflower has also been observed by Dashora and Sharma (2006), which corroborates the present findings.

Significant varietal differences could be noticed for its average oil content in both the years

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and pooled condition. Significant treatment influence i.e., pre-flowering S-application with different dose in soil as well as interaction effect were also noticed in all situations.

Average oil content (%) was consistently highest after Bhima followed by A300, A200 and A1 over the years of experiment as well as in pooled condition. All the varieties were found to be significantly different from each other with almost similar performance over the years especially for this character, which may be due to the typical expression of its genetic control. Application of sulphur both @ 40 and 60 kg.ha^{-1} influenced the enhancement in average oil content of seed in significantly similar manner irrespective of the years and it is to be noted also that average oil content was also enhanced even after application of 20 kg S.ha^{-1} over control (without S-application).While considering the interaction effects, significantly highest oil content was observed after Bhima when it was applied with both 40 and 60 kg.ha^{-1} S in both the years and in pooled condition. Whereas, the lowest oil content was recorded after A1 in control *i.e.*, without S-application. The varieties responded towards S-application with varying doses in very variety specific manner irrespective of the year. Oil content of A1 and Bhima enhanced with the increase in S-doses, it was reduced over control in A200 after application of 20 kg.ha^{-1} S and then enhanced, and no significant differences could be sorted out for oil content of A300 due to doses of S-application, though superior to that of control. Considering the capability of higher S-doses in influencing this parameter, application @ 40 kg.ha^{-1} may be effectively utilized for enhancement in oil content of safflower. Observation of Prakash and Singh (2002) on enhancement in oil content in Indian mustard after sulphur application upto 40 kg.ha^{-1} corroborate the findings of the present investigation. Contradiction with the observation of Dashora and Sharma (2006) on enhancement in oil content upto 60 kg.ha^{-1} S may be due to utilization of single variety in their experiment with different genetic make-up. Though varietal response towards sulphur application in enhancement of seed yield and oil content was observed to be in genotype specific manner, application of 40 kg.ha^{-1} S, on an average, may be recommended for safflower while enhancement in both seeds and oil yield in concern.

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Table1:Variation in seed yield plant^{-1} (gm) among safflower varieties as influenced by sulphur application

	1st Year					2nd Year					Pooled				
	T_0	T_1	T_2	T_3	MEAN	T_0	T_1	T_2	T_3	MEAN	T_0	T_1	T_2	T_3	MEAN
V_1	8.45	10.45	8.05	6.55	8.37	7.40	9.70	7.40	6.15	7.66	7.92	10.07	7.72	6.35	8.02
V_2	10.75	10.80	11.25	10.25	10.76	10.20	10.20	10.65	9.65	10.17	10.47	10.50	10.95	9.95	10.47
V_3	7.75	10.45	7.20	10.45	8.96	7.35	9.80	6.90	10.90	8.73	7.55	10.12	7.05	10.67	8.87
V_4	8.55	7.05	8.35	9.50	8.36	7.05	7.55	7.10	8.90	7.65	7.80	7.30	7.72	9.20	8.01
Mean	8.87	9.68	8.71	9.18		8.00	9.31	8.01	8.90		8.43	9.50	8.36	9.04	
	SED		**LSD (0.05)**		**LSD**	**SED**		**LSD (0.05)**		**LSD**	**SED**		**LSD (0.05)**		**LSD**
V	**0.347**		**0.787**		**1.130**	**0.291**		**0.659**		**0.946**	**0.278**		**0.630**		**0.905**
T	**0.355**		**0.721**		**0.967**	**0.264**		**0.535**		**0.718**	**0.283**		**0.574**		**0.770**
V x T	**0.707**		**1.474**		**2.014**	**0.542**		**1.136**		**1.550**	**0.564**		**1.176**		**1.607**

Table 2: Variation in oil content (%) among safflower varieties as influenced by sulphur application

	1st Year					2nd Year					Pooled				
	T_0	T_1	T_2	T_3	MEAN	T_0	T_1	T_2	T_3	MEAN	T_0	T_1	T_2	T_3	MEAN
A_1	26.55	26.90	29.76	29.45	28.16	25.82	26.59	29.80	29.54	27.94	26.19	26.74	29.78	29.50	28.05
A_{200}	28.36	27.51	28.98	29.04	28.46	28.13	27.35	28.65	28.90	28.26	28.25	27.43	28.82	28.97	28.37
A_{300}	29.56	30.85	30.77	31.03	30.55	29.43	30.61	30.62	30.79	30.37	29.45	30.73	30.70	30.91	30.46
Bhima	30.25	31.02	31.50	31.35	31.03	30.10	30.87	30.97	31.28	30.80	30.18	30.94	31.23	31.32	30.92
Mean	26.68	29.07	30.25	30.22		28.37	28.85	30.01	30.13		28.53	28.96	30.13	30.17	
	SED		**LSD (0.05)**		**LSD**	**SED**		**LSD (0.05)**		**LSD**	**SED**		**LSD (0.05)**		**LSD**
V	**0.063**		**0.134**		**0.185**	**0.109**		**0.232**		**0.320**	**0.729**		**0.154**		**0.213**
T	**0.063**		**0.134**		**0.185**	**0.109**		**0.232**		**0.320**	**0.729**		**0.154**		**0.213**
V x T	**0.127**		**0.269**		**0.371**	**0.219**		**0.465**		**0.641**	**0.145**		**0.309**		**0.426**