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RESEARCH ARTICLE

Response of Water Sodicity (SAR) on Growth, Yield, Oil Content and Uptake of Nutrients by Safflower

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ABSTRACT

A green house experiment was conducted to find out the response of water sodicity (SAR) on growth, yield, oil content and uptake of nutrients" by safflower. The present study comprised 5 levels (control, 10. 20. 30 and 40) of SAR in irrigation water. It was recorded that plant height. number of branches plant"[1], number of head plant' , number of seeds head . stover, seed yield and oil content decreased significantly with increasing levels of SAR in irrigation water over control in both the con. Seductive years except 10 SAR in case of stover, seed yield and oil content which were statistically at par with'the control. The content and uptake of nitrogen, phosphorus, calcium, magnesium and sodium increased while potassium decreased with increasing levels of SAR in irrigation water in both years of experimentation, safflower crop can be grown successfully upto 10 SAR level in irrigation water. The sodium dominated water had impact on the physio-chemical properties of the soil.
Keyword: *Water SodicIty, Oil Content, Nutrients*

INTRODUCTION

The underground irrigation water contains number of dissolved salts which promote salinization and alkalinization in arid and semi-arid climatic conditions, such problematic situation is responsible for poor germination. Stunned crop growth and disturbance in nutrients he decline of crop production. Besides salinity, alkalinity is also a problem of Agra region. This problem may be due to use of poor quality underground irrigation water dominated in the sodium. Excess sodium in irrigation water increase the exchangeable sodium in the soil which affect the physical properties of soil and plays a significant role in making a soil infertile, in order to unilze brackish water, knowledge of tolerance of crop with respect to water sodicity is the pre-requisite. Safflower is most important crop which can be grown under aried and semi-arid salt affected region containing 24-36 percent oil depending upon the varieties. Its oil used for edible and non-edible purpose in different countries of world. Oil is used as non edible for paints, varnishes, printing ink, oil cloth, soaps, water proof fabrics and feed for animals. The by-product of safflower "Saffola" recommended for patients of high blood pressure and tendency of heart attack. Young safflower leaves contain fair amount of iron and an appreciable amount of carotene; hence they are used as good fodder for a live-stock. It grows in Rabi season in Indian climate, with little or no management in his production.

MATERIALS AND METHODS

A green house experiment was conducted during Rabi season of two consequent years 1998-99 and 1999-2000 in the Deptt. of Agricultural Chemistry & Soil Science at R.B.S. College, Bichpuri, Agra. The experimental soli was sandy loam in texture and alkaline in reaction contained 65% sand, 20%, silt and 14.6% clay. The pH, ECe and ESP of the soil were 8.7, 1.7 dSm"[1] and 2.30 respectively. The contents of Ca, Mg, Na and K were 4.2, 5.1, 6.4 and 0.2 me/1 respectively, while

COT, HCQ_3", CT and SO_4 were 1.0, 7.5, 6.7 and 3.2 me/1, respectively in the saturation extract of the soil. The soil had organic carbon 0.4%, available N 148.5 kg ha"[1], available P 25.2 kg ha^{-1} available K. 390 kg ha^{-1}. The pots were filled with well mixed 10 kg soil. Recommended doses of fertilizers (40:40:20 kg/ha "N, P_2O_5) and K_2O) were applied, after filling the pots safflower seeds were sown. The observations were recorded regarding plant height, number of branches $plant^{-1}$, number of heads $plant^{-1}$, number of seeds $head^{-1}$, stover, seed yield and oil content. Standard methods were adopted for chemical analysis.

RESULTS AND DISCUSSION

Perusal of data in Table 1 shows that plant height of safflower decreased significantly with incxcreasing levels of SAR in irrigation water In both the years of study except 10 SAR level, Which was at par statistically with the control. The reduction in plant height was 0.50, 18.17, 28.88, 37.82 per cent in first year and 0.5, 14.61, 27.52 37.67 per cent in second year at 10, 20, 30 and 40 SAR level respectively, over control. Number of branches plant"[1] reduced 0.90, 3.78, 26.10, 38.98 per cent in first year and 1.50. 4.25. 28.87, 55.00 per cent in second year at 10, 20, 30 and 40 SAR levels in - respectively, over control. The maximum reduction in plant height and number of branches $plant^{-1}$ was noted at 40 SAR level in both the years. Similar results have also been recorded by Bains and Fireman (1964) and Yadav (1997).

Number of heads $plant^{-1}$ decreased with increasing levels of SAR in irrigation water and significant reduction was recorded at SAR 30 onwards in both the years of experimentation. The maximum reduction was 22, 63 per cent in first year and 27.89 per cent in second year at 40 SAR level over control. The number of seed head"[1],, decreased significantly with every increasing level of SAR except 10 SAR in both the crop. The control and 10 SAR respect to no. of seeds $head^{-1}$. The maximum reduction was noted as 75.93 per cent ana 72.19 per cent at 40 SAR level in first and second year. It seems that increasing sodium and other toxic tons promote the hindrance in proper balance and adequate amount of availability of essential nutrients caused the reduction in number of heads per plant and number of seeds per head. Similar finding have also been reported by Singh and Abrol (1986).

Stover yield:

The Hover yield of safflower reduced significantly with the increasing level of SAR except 10 in both the crop seasons. Stover yield of safflower reduced at each higher level of SAR by 2.00, 7.20, 33.28 and 64, 56 percent in first year and 2.14, 7.82, 32.99 and 61.98 percent in second year at 10, 20, 30 and 40 SAR level respectively over control.

Seed yield:

The seed yield was decreased significantly with increasing level of SAR except 10 SAR which was at par statistically with the control in both crop seasons. The data regarding seed yield show that significant reduction was observed with each higher level of SAR as 0.7, 7.20, 30.50 and 41.43 i firs, year and 122, 7.88. 29.04 and 41.70 per cent in second year at 10,20,30 and 40 SAR level respectively over control.

It is clear from these findings pertaining to stover and seed yield of safflower severely affected by sodium dominated solution around root tips resulted low absorption, stunned growth and yield of plant. These observations are in agreement with the works of Nieman *et al.* (1988).

Oil content:

The oil content in safflower seed decreased significantly with increasing level of SAR in irrigation water except SAR 10 in first year over control, in both the years of experimentation. The reduction of oil content was noted 10.71, 20.35. 30.96 and percent in first year and 9.53,17.26, 26.90 and 32.55 percent in second year at SAR 10, 20 and 30 and 40 over control respectively. SAR 10 showed better performance with respect to oil content over each higher treatment, the findings are

in agreement. The findings are in agreement with Singh et al., (1979) and Singh and Abrol 1986). They have also reported that oil content decreased with increasing sodicity of irrigation water.

Further Table 2 shows that enhancing levels of SAR in irrigation water increased significantly the content of nitrogen, phosphorus, calcium, magnesium, sodium and decreased the potassium of safflower plant in both the years of experimentation over control. However uptake of nitrogen increased upto 10 SAR, phosphorus 20 SAR, calcium 10 SAR, magnesium 20 SAR and sodium upto 40 SAR level in irrigation water in both the Rabi season experiments. Thereafter reducing trend was observed. The uptake of potassium decreased at each higher level of SAR in irrigation water. The findings are in agreement with works of Bains and Fireman (1964).

Soil studies:

The observation shows that pH, ECe cations and anions me/l (Na^+, Ca^{++} +Mg^{++}, K^+, Cl^-, SO_4^{--}) of soil saturation extracted ESP of soil were increased with increasing each level of SAR in irrigation water while concentration of CO_3^{--} + HCO_3^- and hydraulic conductivity of soil decreased slightly with increasing levels of SAR in irrigation water after harvesting the safflower crop in both the years of study. The maximum values of these components in soil were recorded at 40 SAR level in irrigation water. The findings are in agreement with the works of Kanwar and Kanwar (1978), Lal and Singh (1978). The concentration of CO_3^{--} + $HCO3^-$ not much more affected with increasing levels of SAR in irrigation water in both the years in soil which was analyzed after crop harvest.

Table 1: Plant height, number of branches plant^{-1}, number of heads plant^{-1}, number of seeds head^{-1}, stover yield and oil content of safflower

Treatments SAR	Plant height (cm)		No. of branches plant^{-1}		No. of heads plant^{-1}		No. of seeds head^{-1}		Yield (gm pot^{-1})				Oil content (%)	
									Stover		Seed			
	I*	II*	I*	II*	I*	II*	I*	II*	I*	II*	I*	II*	I*	II*
Control	67.60	68.30	7.67	8.00	17.67	19.00	30.33	31.00	167.87	169.50	53.27	54.50	28.00	28.32
10	67.10	67.90	7.60	7.88	17.16	18.70	28.00	28.33	164.50	165.87	52.87	5.83	25.00	25.62
20	55.23	58.32	7.38	7.66	16.00	16.68	20.00	21.68	155.77	156.23	49.43	50.20	22.30	23.43
30	48.00	49.50	5.66	5.69	15.00	15.70	14.67	16.30	112.00	113.57	37.00	38.67	19.33	20.70
40	41.97	42.57	4.68	3.60	13.67	13.70	7.30	8.62	60.17	64.43	31.20	31.77	19.00	19.10
S.EM±	1.1294	0.6163	0.4346	0.3073	0.6325	0.4944	0.9603	0.2472	1.8403	0.3368	1.7894	0.3600	1.0488	0.5642
CD at 5%	3.6832	2.0097	1.4174	1.0022	2.0625	1.6124	3.1318	0.8062	6.0077	1.0994	5.8357	1.1711	3.4204	1.8393

Table 2: Effect of SAR levels in Irrigation water on N, P, K, Ca, Mg and Na Content (%) and uptake (mg pot^{-1}) in Safflower

Treatments SAR	Content											
	Nitrogen		Phosphorus		Potassium		Calcium		Magnesium		Sodium	
	I	II	I	II	I	II	I	II	I	II	I	II
Control	1.49	1.51	0.13	0.13	1.17	1.17	0.84	0.85	0.29	0.29	0.55	0.56
10	1.53	1.53	0.13	0.14	1.13	1.14	0.86	0.89	0.31	0.32	0.67	0.68
20	1.56	1.58	0.16	0.16	1.12	1.11	0.89	0.89	0.32	0.33	0.89	0.88
30	1.58	1.59	0.17	0.17	1.06	1.09	0.86	0.87	0.36	0.36	1.24	1.50
40	1.56	1.55	0.18	0.19	0.83	1.90	0.79	0.81	0.41	0.42	1.55	1.58
S.Em±	0.0074	0.0032	0.0081	0.0039	0.0144	0.0265	0.0089	0.0064	0.0121	0.0045	0.0263	0.0092
CD at 5%	0.0241	0.0103	0.0263	0.0126	0.0485	0.0864	0.0296	0.0208	0.0393	0.0148	0.0858	0.0302
Uptake (mg pot^{-1})												
Control	2506.6	2553.8	212.6	220.3	1964.0	2013.1	1410.1	1435.1	481.3	491.6	917.6	932.2
10	2522.1	2526.7	214.8	232.2	1847.4	1885.4	1415.2	432.0	510.4	525.2	1108.4	1122.4
20	2429.8	2463.3	244.1	244.8	1739.7	1755.0	1386.4	395.7	497.9	510.4	1380.1	1384.9
30	1765.4	1779.2	186.2	189.8	1187.4	1222.7	967.0	988.0	402.9	412.6	1391.8	1399.0
40	938.6	1000.9	110.3	120.3	501.4	580.0	475.4	524.0	246.6	268.6	932.7	942.9
S.Em±	24.2216	6.26	11.7798	5.2580	0.2878	18.490	0.2545	9.1150	0.2086	7.2240	0.3400	10.4150
CD at 5%	98.9910	20.3780	38.4160	17.1460	0.9386	60.2990	0.8299	29.725	0.6703	23.5604	1.1089	33.9640

I- First experimental year 1998-99 Rabi Season
II- Second experimental year 1999-2000 Rabi Season

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