

## Quality of irrigation water in the sugarcane growing areas Kancheepuram district

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**Abstract:** A study was carried out in the three sugarcane growing divisions (Millsite, Seethancheri and Uttiramerur) of Uttiramerur taluk of Kancheepuram district of Tamil Nadu to assess the quality of irrigation water. The reaction of irrigation waters was neutral (6.8 to 7.8) in Millsite and Seethancheri cane divisions while it was mildly alkaline in some locations of Uttiramerur cane division. The electrical conductivity values indicated that the soluble salt content was more in Uttiramerur when compared to Millsite and Seethancheri cane divisions. Most of the samples (71.43%) registered the Residual Sodium Carbonate (RSC) values of  $<1.25$  m.e.  $L^{-1}$ . About 25 per cent of the samples had recorded  $>2.5$  m.e.  $L^{-1}$  and 3.57 per cent of the samples recorded RSC values of 1.25 to 2.5 m.e.  $L^{-1}$ .

Out of twenty eight water samples, twenty two samples were classified under high salinity ( $C_3$ ), five water samples under medium salinity ( $C_2$ ) and one water sample under very high salinity ( $C_4$ ). With respect to sodicity, twenty three samples were classified under low sodium water ( $S_1$ ), four samples under medium sodium water ( $S_2$ ) and one sample under high sodium water ( $S_3$ ).

**Key words :** *Quality of irrigation water, Sugarcane.*

### Introduction

Quality of irrigation water is essential to maintain the soil and crop productivity to a higher level. The quality of irrigation water should be safe to use for achieving higher yield of crops without damaging soils. In India, increasing trend of irrigated area has led to 3.58 M ha and 5.50 M ha of saline and alkali soils respectively (FAI, 1998). This contributes about 6.4 per cent of net sown area.

Quality of irrigation water is an important consideration in the appraisal of salinity or alkalinity conditions in an irrigated area. Since the quality of irrigation water is one of the important criteria for getting higher yields, the assessment of quality of irrigation water not only helps in predicting suitability of water to crop growth but also maintaining the soil health. About 1.7 lakh hectare of sugarcane growing area is reported to be affected to

varying degrees of saline water irrigation in our country (Sundara and Syam Sundar Reddy, 1994). Decline in sugarcane yield due to saline water irrigation ranged from 10 to 50 per cent (Ramalingaswamy *et al.* 1986). In this context, a study was conducted aiming at assessment of quality of irrigation water during 1998-99 in the operational area of S.V.Sugar Mills Pvt. Ltd., Uttiramerur taluk, Kancheepuram district of Tamil Nadu.

### Materials and Methods

Twenty eight water samples were collected from the bore wells or open wells of the sugarcane growing area encompassing the operational area of S.V.Sugar Mills Pvt. Ltd., Uttiramerur taluk, Kancheepuram district of Tamil Nadu. The water samples were collected and analysed for quality parameters as per the standard procedure given by United States Salinity Laboratory Staff (1968). The irrigation water

S. No.	pH	EC (dSm <sup>-1</sup> )	Soluble anions (m.e.L <sup>-1</sup> )				Soluble cations (m.e.L <sup>-1</sup> )				SAR	RSC	Water quality		
			CO <sub>3</sub> <sup>-</sup>	HCO <sub>3</sub> <sup>-</sup>	Cl <sup>-</sup>	SO <sub>4</sub> <sup>-</sup>	BO <sub>3</sub> <sup>-</sup>	Ca <sup>++</sup>	Mg <sup>++</sup>	Na <sup>+</sup>			K <sup>+</sup>	EC	SAR
<i>Millsite</i>															
1	7.80	0.74	-	6.80	1.41	0.04	0.07	3.10	2.84	3.08	0.07	1.79	0.87	C <sub>2</sub>	S <sub>1</sub>
2	7.70	0.64	-	4.00	2.73	0.04	0.10	2.58	1.98	2.20	0.11	1.46	-0.56	C <sub>2</sub>	S <sub>1</sub>
3	7.00	1.05	-	6.80	4.00	0.07	0.11	4.13	2.49	4.89	0.07	2.69	0.18	C <sub>2</sub>	S <sub>1</sub>
4	7.40	0.62	-	5.20	1.93	0.03	0.12	4.21	2.06	1.65	0.07	0.93	-1.08	C <sub>2</sub>	S <sub>1</sub>
5	7.00	0.83	-	6.80	2.49	0.04	0.06	5.16	0.77	3.77	0.05	2.19	0.87	C <sub>2</sub>	S <sub>1</sub>
<i>Seethancheri</i>															
6	7.00	0.88	-	7.06	3.61	0.03	0.08	3.44	1.03	5.72	0.11	3.82	2.59	C <sub>2</sub>	S <sub>1</sub>
7	6.80	0.77	-	6.67	2.19	0.02	0.08	3.01	1.38	3.71	0.11	2.50	2.28	C <sub>2</sub>	S <sub>1</sub>
8	7.10	0.85	-	7.84	2.31	0.02	0.08	2.41	1.20	5.61	0.09	4.18	4.23	C <sub>2</sub>	S <sub>1</sub>
9	7.50	1.48	-	6.67	6.51	0.06	0.09	3.78	1.72	9.98	0.09	6.02	1.16	C <sub>2</sub>	S <sub>1</sub>
10	7.40	1.23	-	7.45	5.73	0.05	0.08	3.18	1.63	7.86	0.09	5.07	2.63	C <sub>2</sub>	S <sub>1</sub>
11	7.00	1.76	-	5.10	10.45	0.11	0.04	4.13	3.01	10.39	0.14	5.50	-2.04	C <sub>2</sub>	S <sub>1</sub>
<i>Uttiramerur</i>															
12	7.50	0.46	-	3.14	1.61	0.02	0.03	3.35	0.95	0.98	0.05	0.67	-1.18	C <sub>2</sub>	S <sub>1</sub>
13	7.50	0.93	-	6.67	3.05	0.02	0.03	2.49	1.38	5.76	0.09	4.14	2.80	C <sub>2</sub>	S <sub>1</sub>
14	8.40	1.14	2.35	10.98	1.36	0.02	0.06	0.77	0.34	12.23	0.09	16.35	12.21	C <sub>2</sub>	S <sub>1</sub>
15	7.90	1.34	-	9.41	5.71	0.03	0.11	3.01	7.22	4.50	0.09	1.99	-0.82	C <sub>2</sub>	S <sub>1</sub>
16	7.20	1.16	-	6.67	3.49	0.08	0.12	3.61	7.40	1.96	0.07	0.84	-4.34	C <sub>2</sub>	S <sub>1</sub>
17	8.30	1.10	1.57	5.88	5.78	0.05	0.03	1.89	1.63	8.04	0.07	6.06	3.92	C <sub>2</sub>	S <sub>1</sub>
18	7.00	1.58	-	3.92	9.90	0.04	0.07	9.29	4.04	2.55	0.14	0.99	-9.41	C <sub>2</sub>	S <sub>1</sub>
19	7.10	1.58	-	3.92	19.41	0.07	0.05	7.48	8.17	10.76	0.14	3.85	-11.73	C <sub>2</sub>	S <sub>1</sub>
20	8.30	1.00	0.78	5.49	5.04	0.03	0.06	2.49	6.36	1.83	0.14	0.87	-2.58	C <sub>2</sub>	S <sub>1</sub>
21	7.00	0.98	-	4.31	2.38	0.04	0.05	3.70	2.75	3.83	0.09	2.13	-2.14	C <sub>2</sub>	S <sub>1</sub>
22	7.00	0.92	-	4.31	3.89	0.04	0.06	5.25	0.17	2.70	0.14	1.64	-1.10	C <sub>2</sub>	S <sub>1</sub>
23	7.00	1.14	-	8.23	4.08	0.03	0.13	2.32	2.92	6.60	0.11	4.07	2.99	C <sub>2</sub>	S <sub>1</sub>
24	7.80	0.62	-	3.92	2.34	0.02	0.09	3.87	0.77	2.01	0.05	1.32	-0.72	C <sub>2</sub>	S <sub>1</sub>
25	7.20	1.27	-	6.27	4.96	0.04	0.08	4.30	2.32	6.31	0.07	3.47	-0.35	C <sub>2</sub>	S <sub>1</sub>
26	7.60	1.12	-	4.71	5.23	0.04	0.04	4.30	3.35	3.08	0.11	1.57	-2.95	C <sub>2</sub>	S <sub>1</sub>
27	7.90	0.84	-	4.31	4.33	0.03	0.09	4.47	0.26	3.19	0.09	2.07	-0.42	C <sub>2</sub>	S <sub>1</sub>
28	7.40	0.88	-	5.10	2.89	0.02	0.09	4.82	3.01	1.87	0.11	0.95	-2.73	C <sub>2</sub>	S <sub>1</sub>

was classified based on Residual Sodium Carbonate (RSC) as per Eaton (1950) and salinity and sodicity classes as per United States Salinity Laboratory Staff (1968).

### Results and Discussion

All the twenty eight water samples were free from any suspended materials and were found to be quite clear. The results of analysis of quality of irrigation water are presented in Table 1. The pH values ranged from 7.00 to 7.80, 6.80 to 7.50 and 7.00 to 8.40 in Millsite, Seethacheri and Uttiramerur cane divisions. The pH of water samples of Millsite and Seethancheri cane divisions was neutral and it was mildly alkaline in some locations of Uttiramerur cane division. Hence the irrigation waters of the mildly alkaline areas should be carefully used to avoid the development of alkalinity in the soil. The soluble salt concentration varied from 0.62 to 1.05 dSm<sup>-1</sup>, 0.77 to 1.76 dSm<sup>-1</sup> and 0.46 to 2.55 dSm<sup>-1</sup> in Millsite, Seethancheri and Uttiramerur cane divisions. The soluble salt concentration was more in Uttiramerur when compared to Millsite and Seethancheri cane divisions. The frequency of irrigation should be maintained at possible minimum to avoid the development of soil salinity in Uttiramerur cane division. These waters can be used for irrigation with proper ameliorative measures. The other samples are suitable for irrigation for all soil types and crops.

#### Soluble anions

The carbonate noticed only in three samples of Uttiramerur cane division and it ranged from 0.78 to 2.35 m.e. L<sup>-1</sup>. Bicarbonates content of Millsite, Seethancheri and Uttiramerur cane divisions varied from 4.00 to 6.88 m.e.L<sup>-1</sup>, 5.10 to 7.84 m.e.L<sup>-1</sup> and 3.14 to 10.98 m.e. L<sup>-1</sup>. The chloride concentration ranged from 1.41 to 4.00 m.e.L<sup>-1</sup>, 2.19 to 10.45 m.e.L<sup>-1</sup> and 1.36 to 19.41 m.e.L<sup>-1</sup> in Millsite, Seethacheri and Uttiramerur cane divisions respectively. Sulphate concentration varied from 0.02 to 0.11 m.e.L<sup>-1</sup> and boron concentration varied from 0.03 to 0.13 m.e.L<sup>-1</sup>. Sulphate and boron concentration in irrigation water were observed to be low in all the water samples of the study area.

#### Soluble cations

The calcium concentration of water samples was found to be in the range of 2.58 to 5.16 m.e.L<sup>-1</sup> in Millsite, 2.41 to 4.13 m.e.L<sup>-1</sup> in Seethancheri and 0.77 to 9.29 m.e.L<sup>-1</sup> in Uttiramerur cane divisions. The magnesium concentration ranged from 0.77 to 2.84 m.e.L<sup>-1</sup>, 1.03 to 3.01 m.e.L<sup>-1</sup> and 0.17 to 8.17 m.e.L<sup>-1</sup> in Millsite, Seethancheri and Uttiramerur cane divisions. The sodium content ranged from 1.65 to 4.89 m.e.L<sup>-1</sup> in Millsite, 3.71 to 10.39 m.e.L<sup>-1</sup> in Seethancheri and 0.98 in 12.23

Table 2. Classification of quality of irrigation water in Uttiramerur taluk

RSC (m.e.L <sup>-1</sup> )	No. of samples	Frequency (%)	EC Class	No. of samples	Frequency (%)	SAR Class	No. of samples	Frequency (%)
<1.25	20	71.43	Low salinity class (C <sub>1</sub> )	Nil	0.00	Low sodium class (S <sub>1</sub> )	23	82.14
1.25-2.5	1	3.57	Medium salinity class (C <sub>2</sub> )	5	17.86	Medium sodium class (S <sub>2</sub> )	4	14.29
>2.5	7	25.00	High salinity class (C <sub>3</sub> )	22	78.57	High sodium class (S <sub>3</sub> )	1	3.57
			Very high salinity class (C <sub>4</sub> )	1	3.57	Very high sodium class (S <sub>4</sub> )	Nil	0.00



m.e.L<sup>-1</sup> in Uttiramerur cane divisions. The potassium concentration varied from 0.05 to 0.11 m.e.L<sup>-1</sup> in Millsite, 0.09 to 0.14 m.e.L<sup>-1</sup> in Seethancheri and 0.05 to 0.14 m.e.L<sup>-1</sup> in Uttiramerur cane divisions.

#### Classification of quality of irrigation water

Presence of sodium salts and their concentration in water decide the quality of irrigation water. Water samples containing carbonates and bicarbonates in excess of calcium and magnesium are harmful. Carbonates and bicarbonates aggravate the sodium hazards by precipitating the calcium and magnesium ions. The classification of quality of irrigation water is presented in Table 2. Eaton (1950) classified waters on the basis of Residual Sodium Carbonate values as suitable (<1.25 m.e.L<sup>-1</sup>), moderately suitable (1.25 - 2.5 m.e.L<sup>-1</sup>) and unsuitable (>2.5 m.e.L<sup>-1</sup>) for irrigation. The water samples of 71.43 per cent are suitable for irrigation, 25.57 per cent of the samples are moderately suitable and 2.5 per cent unsuitable for irrigation. Continuous application of the water with >2.5 RSC values will induce accumulation of carbonates and bicarbonates in soils and impair the crop growth. Special precautions are needed in irrigation to prevent lime accumulation and possible soil alkalization. More frequent irrigation is necessary to prevent soil drying and leaching has to be done at frequent intervals under these situations. The irrigation water classified according to United States Salinity Laboratory Staff (1968) revealed that under electrical conductivity classes 17.86 per cent was medium salinity water (C<sub>2</sub>), 78.57 per cent high salinity water (C<sub>3</sub>) and 3.57 per cent very high salinity water (C<sub>4</sub>). Among these three groups, high salinity water can be used for irrigation for soils with very good drainage whereas very high salinity water is not suitable for irrigation for many of the soil groups. Boron concentration more than 2.00 ppm may be injurious to crop if used on heavy soils. Since irrigation water samples

in the study area contains <1 ppm there is no limitation with regard to boron concentration.

The classification of irrigation water with respect to Sodium Adsorption Ratio (SAR) is based on the abundance of exchangeable sodium particularly on the physical condition of the soils. The irrigation water samples of Uttiramerur taluk were grouped under 3 SAR classes viz. S<sub>1</sub> - low sodium water (82.1%), S<sub>2</sub> - medium sodium water (14.29%) and S<sub>3</sub> - high sodium water (3.57%). Irrigation waters with S<sub>2</sub> class will produce appreciable sodium hazard in fine textured soils. Therefore, proper soil management practices have to be adopted while irrigating on the fine textured soils. Chemical amendments like gypsum have to be applied to the soils while irrigating with the S<sub>3</sub> class water.

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