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Quality Survey of Marh-Chiniot (M-C) Drain Water Under Seasonal Variations

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Abstract: Limited supply of canal water forces for seeking alternative sources for the supplementation. For this purpose, the quality of Marh-Chiniot (M-C) drain water was tested in different seasons from irrigation/ reclamation point of view. Results indicated that EC of the waters varied in sampling seasons at different sampling points. In general, EC values ranged between 0.25 and 2.69 dSm^{-1}. Its mean values were calculated as 1.08, 1.06, 1.83 and 1.85 dSm^{-1} during August 1997, December 1997, June 1998 and February 1999 respectively. The mean SAR of these waters was found below the safe limit of 10 $(m.mol\ L^{-1})^{½}$ with only one exception for June 1998 when it was having this parameter in marginal range. Respective mean values of SAR for the above months were 8.26, 5.42, 11.79 and 9.5 $(m.mol\ L^{-1})^{½}$. Values of RSC were found generally high with its computed means of 4.71, 4.13, 7.98 and 6.31 me. L^{-1} for August, December 1997, June 1998 and February 1999 respectively. The quality of waters varied from upstream to downstream, without a definite trend. The seasonal effect was very much pronounced depending upon the flow of water. It may be concluded that this water can be used for crop production and reclamation purposes with some suitable management practices. However, frequent quality assessment will be needed especially, in different seasons.

Key words: Water quality survey of Marh-Chiniot (M-C) Drain

Introduction

Construction of open drains is one of the approaches to carry excess water from waterlogged areas. Under the SCARP Project, WAPDA has constructed a network of drains in the Punjab. These drains carry drainage water, rainwater, floodwater and some city/industrial wastewater. Thus, the quality of drain water changes not only from point to point but also with season. In the rainy and flood season and just afterwards, water quality may be good enough while in winter and early summer season, it may be degraded due to limited total flow or concentration. Hussain *et al.* (1991) analyzed waters from Maduana, Awagat, Samundri and Jaranwala drains and claimed these waters marginally fit for crop production. Consulting the salt tolerance tables for different crops prepared by Maas (1986) and quality standards of Land Reclamation Directorate and WAPDA (Ahmad, 1974), it can be expected that drainage water may safely be used for crop production and reclamation, especially under water stress conditions as have been created by consistent present drought. Similar survey of AKN Drain indicated that drainage water could be used for the production of salt tolerant crops like rice, wheat barley and cotton when managed through cyclic use strategy or occasional gypsum application. This water could safely be used for reclamation of sodic soils along with gypsum (Jakhar *et al.*, 1993).

Works have been reported whereby drainage waters of higher salinity were successfully used for production of different crops (Rain *et al.*, 1987, Rhoades, 1977, Rhoades *et al.*, 1980; Rhoades *et al.*, 1988a). Salt balance of soil was also kept well in control through recycling of drainage and canal water (Kaddah and Rhoades 1976; Rhoades *et al.*, 1988b). Drain waters are generally disposed into rivers in Pakistan. This practice causes an increase in the salt load of the rivers. If drainage water is used to irrigate salt tolerant crops, this problem may be tackled successfully. Rhoades *et al.* (1974) suggested recycling of drainage water for crop production to decrease significantly the salt pollution of river water. In studies of Hussain *et al.* (1995 a & b) the poor quality water having EC, SAR and RSC of 1.99 dSm^{-1}, 14.45 $(m.mol\ L^{-1})^{½}$ and 2.90 meL^{-1} respectively were successfully managed for crop production of rice, wheat, maize and sorghum when gypsum was applied along with brackish water irrigation's or it was recycled with canal water. Sodic water was also used without any yield losses to rice and wheat crops and potential threat to soil health when gypsum was applied to the soil (Hussain *et al.*, 2000).

Voluminous surface drain water is available in the country and can be a good supplement to canal water if used for crop production under scientific management. Studies were thus, planned to assess the water quality of Punjab

drains and Marh-Chiniot (M-C) drain was selected in the second phase. This drain collects water from 352 square miles of catchment area lying in Hafizabad, Sheikhupura, Faisalabad and Jhang Districts and falls in river Chenab. The drain can carry 1408 cusecs of water with full capacity. The study was carried out to evaluate the quality of drain water with the objective to select the best time and points for lifting and using the water for crop production and reclamation purposes.

Materials and Methods

The Marh-Chiniot (M-C) drain was surveyed in 1997-99 to earmark the sampling points and following 32 such points were selected.

Sr. #	Points	Sr. #	Points
1	Kassoke	17	Chak No. 286 R.B
2	Khanjar Banjar	18	Syphan Rakh Branch
3	Ajniawala	19	Sukheke Branch drain
4	Kalsian	20	Marh Balochan
5	Thatha Assian	21	Kot Nakka
6	Gujiana	22	Murad Kot
7	Mian Ali	23	Vanir Branch drain
8	Khankah Dogran (upstream)	24	Pandorian
9	Khankah Dogran (downstream)	25	Bhaduea Branch drain
10	Islam Pura	26	Theri Branch drain
11	Sukheke	27	Ranika
12	Melluana (upstream)	28	Syphan of Jhang Branch canal
13	Chadar Chak	29	Ahmad Abad
14	Melluana (downstream)	30	Chak Jhumra Road
15	Mangat	31	Faisalabad Road
16	Bajwana	32	Jhang Road

Water samples were collected from the centre of the running drain. Sampling was accomplished four times during August 1997, December 1997, June 1998 and February 1999 from the same points. In all, 128 samples were collected and analyzed for EC, Cations ($Ca^{2+} + Mg^{2+}$ & Na^{1+}) and anions ($CO_3^{2-} + HCO_3^{1-}$, Cl^{1-} & SO_4^{2-}). The values for SAR and RSC were computed from these data. Analysis and computation formulae employed for the estimating parameters of RSC and SAR were those described in Agricultural Hand Book No. 60. (US Salinity Laboratory Staff, 1954) and are reproduced below:

$$RSC\ (meL^{-1}) = (CO_3^{2-} + HCO_3^{1-}) - (Ca^{2+} + Mg^{2+})$$

$$SAR(m.mol\ L^{-1})^{1/2} = \frac{Na^{1+}}{\left[\frac{Ca^{2+} + Mg^{2+}}{2}\right]^{1/2}}$$

(Cations and anions expressed in terms of meL^{-1}).

Results and Discussion

EC of surface drainage water

The indicated minimum mean value of 1.03 dSm^{-1} was observed in December, 1997 whereas maximum value of 1.82 dS m^{-1} was noticed in the month of June, 1998 just before rainy season. Mean values for August, 1997 and February, 1999 were 1.08 and 1.59 dSm^{-1} respectively (Fig. 1). According to the standards of Land Reclamation (1974), these waters are unfit (EC = 1.5 dSm^{-1} = 1000 ppm) in the months of June and February but fit for irrigation in August and December. Using somewhat liberal criteria of WAPDA (Ahmad, 1974), these waters may be designated as fit to marginal (1000-1500 ppm = 1.5 to 2.15 dS m^{-1}) for crop production.

These waters were comparable to majority of ground waters. Drainage waters of this quality were successfully used by Hussain *et al.* (1991 and 1995 a and b) for rice, wheat, maize and sorghum production.

Drain waters of even worst quality have been used with out any serious threat to crop yields and soil characteristics in other parts of the world (Rain, 1987; Rhoades, 1977). If these waters are used just as supplement to canal water and in cyclic strategy (Kaddah and Rhoades, 1976; Rhoades *et al.* 1988b), still better results can be obtained. The supply of water as well as cropping intensity may be increased.

Significant segregations were observed at point No. 9 (Khankah Dogran) in all the seasons which may be due to mixing of town water (Fig. 2 A and B). The point 13 (Chadar Chak) also indicated very high salt content in June 1998. The EC values were also higher at point 14 (Melluana) during June, 1998 and February. 1999 as well as point 23 (Vanir Branch drain) in June 1998. This parameter was also on the higher side at the last point (No. 32, Jhang Road) in all the seasons except August 1997 (the rainy season). The trend of variation from upstream to downstream was not found to be definite.

The above mentioned points should be avoided when lifting the water of this drain for irrigation. The water EC was generally more in June due to concentration effect of high temperature and comparative less flow just before

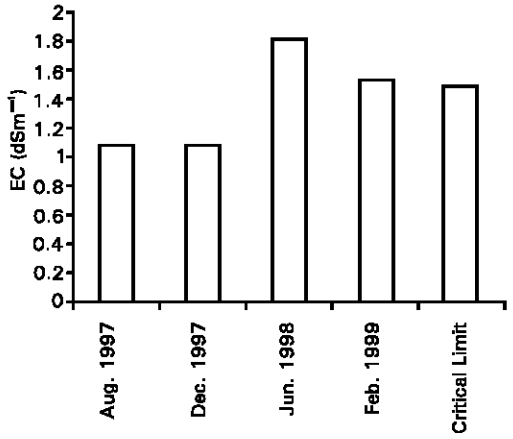

Fig. 1: Mean EC (dSm^{-1}) of Marh-Chiniot Drain

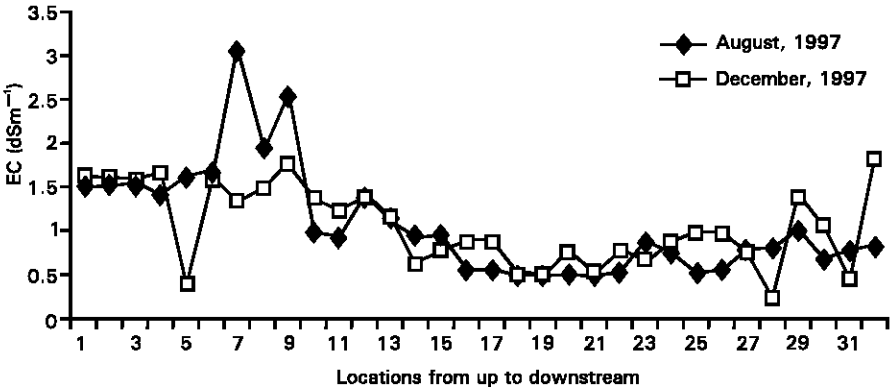

Fig. 2A: EC (dSm^{-1}) of Marh-Chiniot Drain

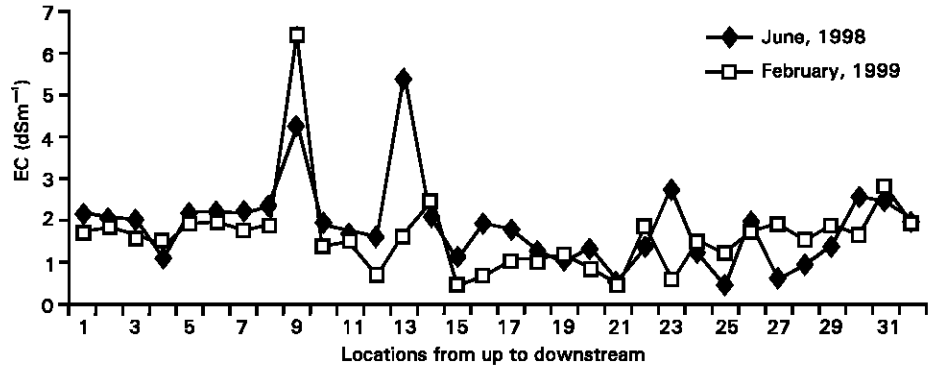

Fig. 2B: EC (dSm^{-1}) of Marh-Chiniot Drain

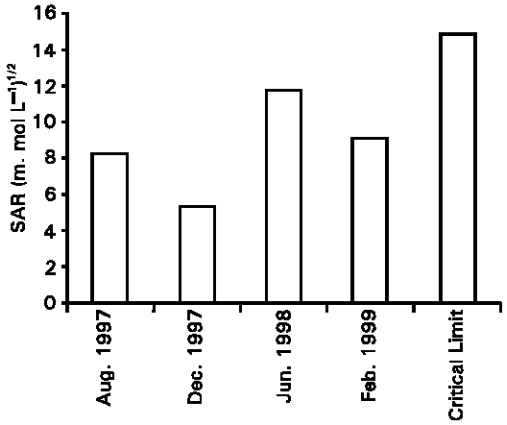

Fig. 3: SAR (m. mol L^{-1}) of Marh-Chiniot Drain

the rainy season. Hence, this month can be avoided for using water of M-C drain.

SAR of surface drainage water: Changes in SAR of M-C drain water with respect to different points and seasons are presented in Fig. 3 and 4 (A and B). Values of this parameter were 8.26, 5.42, 11.79 and 9.15 (m.mol L^{-1})^{½} respectively for the months of August, December, June and February. The average values of June were higher due to some odd figures at point 20 (Marh Balochan), 9 (Khankah Dogran) due to town waste water and point 13 (Chadar Chak) where the water was stagnant in dry season. These are the points where EC of water was also high (previous section). Thus, all the waters except at point 9 and 13 can be classified as fit using yard stick of WAPDA (Ahmad, 1974) for SAR parameter. Even using the criteria of Land Reclamation (1974) these waters could be called fit except in the season of June when the mean value was slightly above the critical limit of 10 (m mol L^{-1})^{½}. The water of SAR 15 (m.mol L^{-1})^{½} was used successfully for crop production (Hussain *et al*., 2000).

RSC of surface drainage water: RSC is a measure, which predicts sodication of soil after $CaCO_3$ and $MgCO_3$ have been precipitated from irrigation water. Average value of RSC during the months of August, December, June and February were 4.71, 4.13, 7.98 and 6.31 meL^{-1} respectively (Fig. 5 and 6 A and B) and the mean values of this parameter were higher than the critical limit of 25 meL^{-1} (Land Reclamation, 1974) in all the seasons. However,

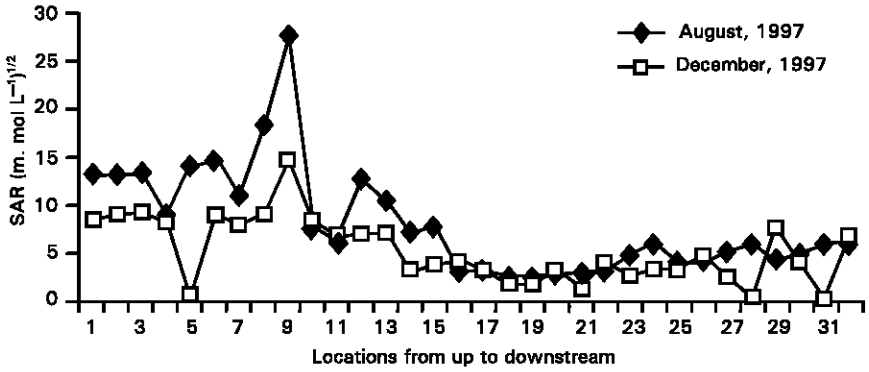

Fig. 4A: SAR (m. mol $L^{-1})^{½}$ of Marh-Chiniot Drain

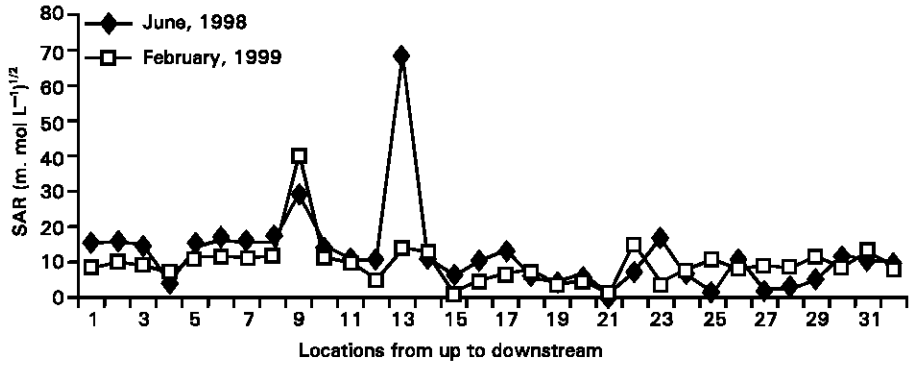

Fig. 4B: SAR (m. mol $L^{-1})^{½}$ of Marh-Chiniot Drain

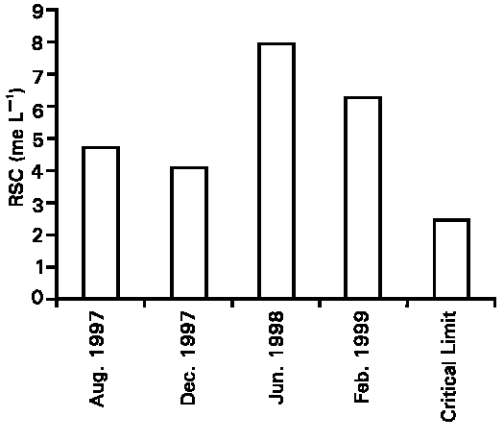

Fig. 5: RSC (me L^{-1}) of Marh-Chiniot Drain

these were within useable range in August and December when assessing criteria of WAPDA (Ahmad, 1974) was used. Very high values of RSC were recorded at point 7 (Mian Ali) and 16 (Bajwana) during August 1997. Similarly, point 9 (Khankah Dogran downstream) and 10 (Islam Pura) were having higher values in December 1997. The points having very high values during June 1998 were 8 (Khankah Dogran upstream), 17 (Chak No. 286 R.B) and 23 (Vanir Branch drain). The points 9 (Khankah Dogran downstream) and 31 (Faisalabad Road) were having more values during February 1999. It may be inferred that during the month of August and December, in general and at certain points except mentioned above in other months, drain water can be lifted and used for crop production safely. If mixed with canal water or used in a cyclic manner, RSC may be diluted and water would not remain hazardous for crops as well as soils. The studies of Hussain *et al.* (2000) support this hypothesis.

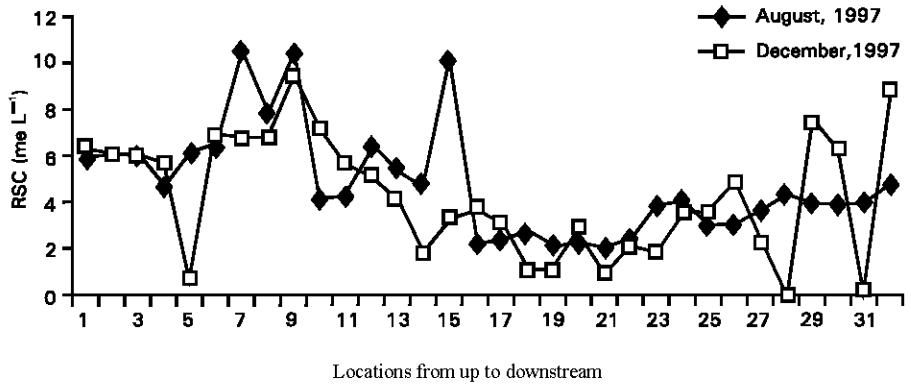

Fig. 6A: RSC (me L^{-1}) of Marh-Chiniot Drain

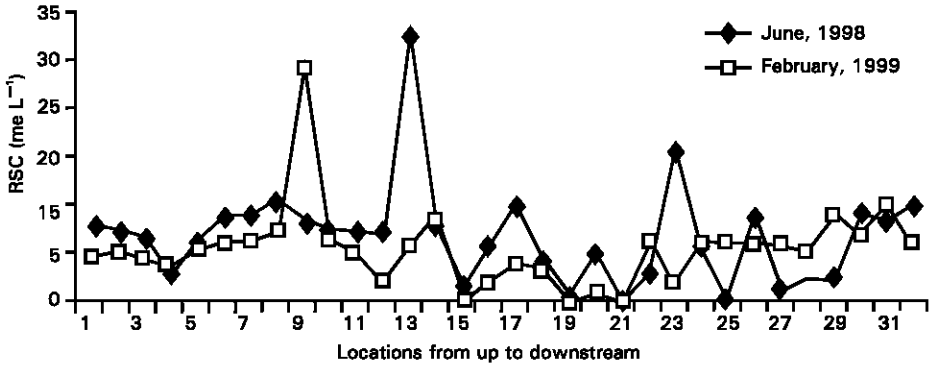

Fig. 6B: RSC (me L^{-1}) of Marh-Chiniot Drain

When this water is deemed to use for reclamation of salt-affected soils along with gypsum application, there would be no significant bad effect.

These investigations indicated that M-C drain water can be used for crop production provided that salt tolerant crops like rice and barley are grown and management practices, cyclic use with canal water and occasional gypsum application are adopted. Green manuring or addition of manures can also be useful. The extreme deficits of canal water can be supplemented with drainage water. This water can safely be used for reclamation of sodic soils along with gypsum. However, during the months of June, in general and at point No. 8 and 9 (Khankah Dogran), 13 (Chadar Chak) and 32 (Jhang Road) in particular should be avoided for using this water.

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