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# COMPOSITION OF UNDERGROUND WATER FROM SOUTHERN PART OF THARPARKAR DESERT FOR CULTIVATION OF CROPS

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Underground water samples collected from open wells and hand pumps from Umerkot, Chachro, Mithi, Islamkot and Diplo in the southern parts of the Tharparkar desert were analyzed for pH, total soluble salts (T.S.S), Na, K, Ca, Mg, N,P, $CO_3$, Cl and $SO_4$. pH 8.6 and total soluble salts (9543 ppm) at some places were not suitable for plant growth. Nitrogen and phosphorus content were in negligible amounts. Calcium, potassium and magnesium were in the range sufficient for plant growth. Sodium (3600 ppm), chloride (4400 ppm), sulphate (792 ppm) and bicarbonate (832 ppm) were dominant ions and the quality of underground water varied from suitable to unsuitable type for growth of agricultural crops in a hydroponic system.

*Key words:* Underground water, Ioncomposition, Thar desert.

## INTRODUCTION

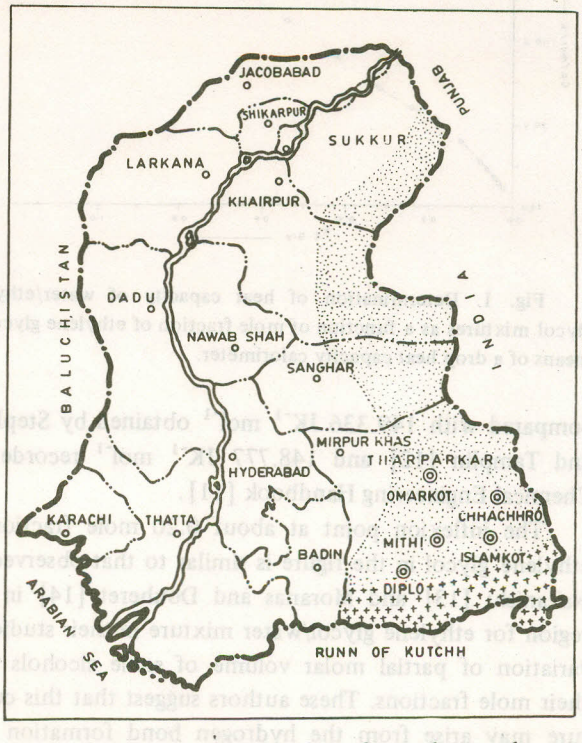
Sandy deserts which consitute a greater part of semi-arid and arid zones of the world have been considered useless for cultivation of crops, because good quality irrigation water is scarce and sub-soil water is generally brackish and contains an appreciable amount of soluble salts [1-3] but modern plant physiological approaches have revealed their agricultural potentialities. Recent developments in hydrology shown the presence of ground water resources in the deserts which could be exploited for irrigation. Though sub-soil water often contains salts beyond the maximum permissible limit recommended for plant growth, the knowledge of chemical amendments and growth through partial root contact techniques have made it possible to raise salt tolerance crops on sandy deserts.

The available water resources in the Thar desert, therefore require a thorough investigation to determine the suitability of underground water after proper amendment for growing crops. With this objective a survey of underground water in the southern part of Thar desert was carried out in order to determine the ionic composition of underground water for growing vegetable crops after mixing with balanced nutrient solution.

The Thar desert is faced with an acute shortage of water for drinking and farming purposes and hence the major reliance for water is on shallow wells. A large number of small open wells exist in the Thar with water level varying from 8 m. to 61 m. deep.

## MATERIALS AND METHOD

The underground water samples were collected from Umerkot, Chachro, Mithi, Islamkot and Diplo in the southern part of Thar desert and stored in screw-capped plastic bottles of one litre capacity. The pH of the water samples was determined by pH meter, and total soluble salts was measured by a conductivity meter bridge. $Na^+$, $K^+$ and $Ca^{++}$ were determined by flame photometry and Mg by EDTA method. Nitrogen was determined by micro-kjeldahl method and P was measured by stannous chloride blue colour method. $CO_3^-$, $HCO_3^-$ and $Cl^-$ were esti-




Map of Sind: Showing the places from where under ground water samples were collected.

mated by titration method and $SO_4^-$ by barium sulphate precipitation. The standard procedures were followed for their determinations [4].

## RESULTS AND DISCUSSION

Anaysis of water samples from different areas of Sind desert are presented in Table 1, which shows that the total soluble salts of water samples varied from 636 ppm (site 1) to 9543 ppm (site 24). Out of 24 water samples examined, only one samples from site I (636 ppm) was of moderate salinity water. Such water can be used if moderate amount of leaching occures and hence plants with moderate salt tolerance can be grown without any special practices for salinity control. Water samples at sites 2 to 9 (790 to 1590 ppm) were of high salinity and may not be used on soils with restricted drainage and only salt tolerant plants can be grown. Water at sites 10 to 24 (1675 ppm to 9543 ppm) were of very high salinity and not suitable for irrigation except under very special circumstances.

The pH of the water samples ranges from 7.1 to 8.6 (Table 1). The dominant cation in water sample was sodium with concentration varying from 28 to 3600 ppm. In the water sample analyzed the sodium concentration at many places was in the range toxic to plants. The concentration of calcium and magnesium in the water samples were sufficient for the growth of plants. Similarly the concentration of potassium in the water sample was adequate except at sites No, 1,2,14,16, and 20. The most dominante anion in the water sample was chloride with concentration varying from 120 to 4400 ppm, whereas, concentration of $Cl^-$ greater than 350 ppm is considered to create problem with crop growth. The content of chloride in the water sample analyzed were generally in toxic amount for the growth of crop. The concentration of bicarbonate anion varied from 120 ppm to 832 ppm. Concentration of $HCO_3$ from 793 to 1220 ppm results in chlorosis in plants and reduces the yield by 60 % as compared to control [5]. Carbonate ion was absent at some places and at other places their concentrations varied from 22 to 280 ppm. Concentration of sulphate was beyond permissible limits in all the samples analyzed. The sodium adsorption ration (SAR) of the water samples analyzed varied from 0.86 to 105.7. Value of SAR $<$ 10 in case of irrigation water is considered as low sodium water, between 10-18 as medium, 18-26 as high and $>$ 26 as very higher or poor water [6]. In fact waters with SAR more than 10 cannot be used on land for irrigation without taking proper measures.

From the surveys of underground water in the Thar desert areas, and analyses conducted it was observed that the quality of underground water, varied from suitable to highly unsuitable types for cultivation of crops. It may be possible at least in some places to use the underground

Table 1. Ionic composition of water samples collected from southern part of Thar desert.

| Site No. | Location (Goth) | Open well or hand pump | Approx. depth (m) | Approx. T.S.S. (ppm) | ECW mmhos/ cm | pH | SAR | Na | K | Ca | Mg | N | P | $CO_3$ | $HCO_3$ | Cl | $SO_4$ |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | ppm | | | | | | | | | |
| 1. | Juryar | Well | 21 | 636 | 0.99 | 7.9 | 1.06 | 38 | 19 | 34 | 38 | – | 0.70 | 80 | 145 | 120 | 115 |
| 2. | Sukhli | " | 38 | 790 | 1.23 | 8.5 | 1.68 | 53 | 11 | 30 | 26 | 2.8 | 1.08 | – | 306 | 194 | 88 |
| 3. | Diplo | " | 15 | 893 | 1.40 | 7.4 | 4.26 | 150 | 24 | 43 | 30 | – | 0.35 | 90 | 120 | 320 | 98 |
| 4. | Vijota | " | 18 | 979 | 1.53 | 7.5 | 0.86 | 28 | 110 | 39 | 27 | 11.2 | 0.56 | 240 | 120 | 280 | 105 |
| 5. | Umerkot | " | 12 | 998 | 1.56 | 7.9 | 2.68 | 90 | 22 | 42 | 26 | 2.8 | 0.88 | – | 294 | 280 | 190 |
| 6. | Thakur | " | 23 | 999 | 1.56 | 7.5 | 3.76 | 120 | 33 | 58 | 12 | 2.8 | 0.88 | – | 278 | 259 | 108 |
| 7. | Katio | " | 38 | 1108 | 1.73 | 7.9 | 4.87 | 140 | 53 | 27 | 21 | 2.8 | – | 24 | 275 | 438 | 115 |
| 8. | Verijup | " | 27 | 1215 | 1.90 | 7.6 | 2.87 | 115 | 35 | 41 | 48 | – | 0.49 | 130 | 120 | 560 | 105 |
| 9. | Umerkot | Hand pump | 27 | 1590 | 2.48 | 7.5 | 4.65 | 200 | 110 | 77 | 38 | 2.8 | 0.88 | – | 428 | 624 | 213 |
| 10. | Mithi | " | 38 | 1675 | 2.62 | 7.6 | 13.04 | 375 | 52 | 23 | 24 | – | 1.05 | 240 | 120 | 560 | 125 |
| 11. | Islamkot | Well | 60 | 1908 | 2.98 | 8.0 | 22.76 | 450 | 8 | 15 | 9 | 5.5 | 1.04 | 140 | 360 | 800 | 80 |
| 12. | Umerkot | Hand pump | 30 | 1953 | 3.05 | 7.8 | 4.54 | 220 | 65 | 54 | 74 | 15.4 | 0.18 | – | 402 | 738 | 214 |
| 13. | Chachro | Well | 33 | 3489 | 5.45 | 7.9 | 14.99 | 700 | 20 | 37 | 76 | 2.8 | 0.88 | 42 | 270 | 1920 | 210 |
| 14. | Islamkot | " | 16 | 4180 | 6.53 | 7.7 | 22.71 | 975 | 19 | 36 | 34 | – | 0.81 | 240 | 120 | 2400 | 96 |
| 15. | Diplo | " | 8 | 4389 | 6.86 | 7.7 | 13.11 | 950 | 150 | 127 | 162 | – | 1.33 | 240 | 120 | 2340 | 144 |
| 16. | Chachro | " | 38 | 4544 | 7.10 | 8.2 | 1.88 | 77 | 16 | 60 | 41 | – | – | 54 | 340 | 3200 | 314 |
| 17. | Lundhar | " | 38 | 4631 | 7.24 | 7.6 | 25.69 | 1300 | 37 | 65 | 77 | 5.5 | 1.05 | 280 | 480 | 2120 | 120 |
| 18. | Naopara | " | 35 | 6907 | 10.79 | 8.0 | 50.90 | 1920 | 25 | 47 | 36 | 8.4 | 0.88 | 22 | 550 | 3480 | 350 |
| 19. | Sinyasar | " | 45 | 6986 | 10.92 | 8.6 | 82.56 | 1500 | 47 | 10 | 9 | 5.6 | 0.70 | 280 | 420 | 4400 | 120 |
| 20. | Piloro | " | 21 | 7279 | 11.39 | 7.5 | 16.33 | 1900 | 10 | 410 | 370 | 1.05 | 1.05 | 120 | 129 | 4021 | 111 |
| 21. | Mithi | " | 30 | 7906 | 12.35 | 7.3 | 29.74 | 2250 | 30 | 101 | 100 | – | 0.70 | 120 | 360 | 4300 | 129 |
| 22. | Nabisar | " | 24 | 8088 | 12.64 | 7.1 | 32.64 | 2500 | 62 | 230 | 476 | – | 0.83 | 120 | 120 | 4220 | 241 |
| 23. | Radhori | " | 38 | 9086 | 14.19 | 7.8 | 26.58 | 2800 | 44 | 36 | 288 | 2.8 | – | 270 | 408 | 4120 | 792 |
| 24. | Chachro | " | 33 | 9543 | 14.91 | 8.3 | 105.76 | 3600 | 26 | 40 | 28 | 11.2 | 0.18 | 64 | 832 | 42 | 419 |

water in the desert for cultivation of crops under hydroponics with proper adjustment of ionic concentrations of irrigation water.

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