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AFFECT OF HIGH SALINITY WATER ON DIFFERENT CROPS AT KHANPUR TALUKA (GUJARAT)

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ABSTRACT

Future demands of the world's limited water resources and the demands to adequately feed expanding population required that irrigation efficiency and crop productivity from irrigated land should be improved. About 75% of India's population is in villages and most of them depends upon agriculture for their live-hood. Previously, they were depend upon the rain fall for the irrigation purposes, which was quit uncertain. Then they started using underground water of wells, tubewells, ponds, rivers etc. This study has been done in order to find out the means of measuring the amount of different chemicals constituents in different irrigation waters and soil of some villages of Khanpur Taluka, Gujarat (India) to find out the suitability for different crops and their verities.

Key words: Salinity water, pH, Ca^{2+}, Mg^{2+}, CO_3^{2-}, HCO_3^-, EC, RSC.

INTRODUCTION

In villages, the main sources of water is underground water available from wells, borewells and hand pumps. Water is the liquid of life and it is very important requirement for agricultural as well as daily life. Water is called the universal solvent. With the increasing population and comparatively low supply of agricultural goods from the farmer's side, it has always been an interest among the scientists to find out new means of improving it. Now a days, the farmers have started using the underground water of wells, ponds, tubewells etc for irrigation. Ground water mainly comes from the seepage of surfaces water and is held in the subsoil and pervious rocks[1]. This water is never (without exception) pure. It always contains some amount of chemical salts dissolved in it.

All salinity water contains dissolved mineral salts, but the concentration and composition of the dissolved salts may vary depending on the sources of the irrigation water. The presence of these salts in irrigation water are table salt (sodium chloride, NaCl), gypsum (calcium sulfate $CaSO_4$), epsom salts (magnesium sulfate, $MgSO_4$) and baking soda (sodium bicarbonate, $NaHCO_3$). Salts dissolve in water and form positive ions (cations) and negative ions (anions). The most common cations are calcium (Ca^{2+}), magnesium (Mg^{2+}) and sodium (Na^+) while the common anions are chloride (Cl^-), sulfate (SO_4^{2-}) and bicarbonate (HCO_3^-). The ratio of these ions however, vary from one water supply to another. Potassium (K^+), carbonate (CO_3^{2-}) and nitrate (NO_3^-) also exist in water supplies, but concentrations of these constituents are comparatively low.

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The presence of these salts alters the pH of water from the normal. Slight deviations from the required optimum values affect the crop and the harvest qualitatively as well as quantitatively. Therefore, an attempt has been made to study the suitability of salinity waters for different crops[2,3].

EXPERIMENTAL

The samples used for irrigation purposes were collected from different villages of Khanpur Taluka in plastic bottles and to prevent any bacterial growth, a few drops of toluene were put as preservative[4].

pH of water was measured by hydrogen ion sensitive electrode of electronic portable kit (Century make) at the sampling site and by pH meter (Systronic) in laboratory. The presence of Ca^{2+} and Mg^{2+} salts in the soil or in irrigation water was done by volumetric titration methods, which involve complex chemical reaction and hence, are truly known as complexometric analysis. It was done by EDTA using Eriochrome Black T as the indicator[4,5]. The amount of Ca^{2+} and Mg^{2+} were always measured in aggregation calculations in samples of different villages. Separate estimations are not required as they are complementary in action to each other. The amounts of carbonate (CO_3^{2-}) and bicarbonate (HCO_3^-) were analysed using standard method[6-8] Table 1 records the observations in different villages.

Table 1: Analysis of irrigation water used in different villages

Villages	pH	Vol. of EDTA used (mL)	Vol. of H_2SO_4 used, if CO_3^{2-} is present (mL)	Vol. of H_2SO_4 used in HCO_3^- estimation (mL)
Dodavanta	7.42	9.8	---	4.5
Khoontelav	7.76	2.6	0.	2.6
Lavana	8.60	3.9	0.7	3.7
Masiya	7.3	2.6	---	2.7
Naroda	8.10	7.8	---	3.8
Sanpadiya	7.22	6.2	---	2.7

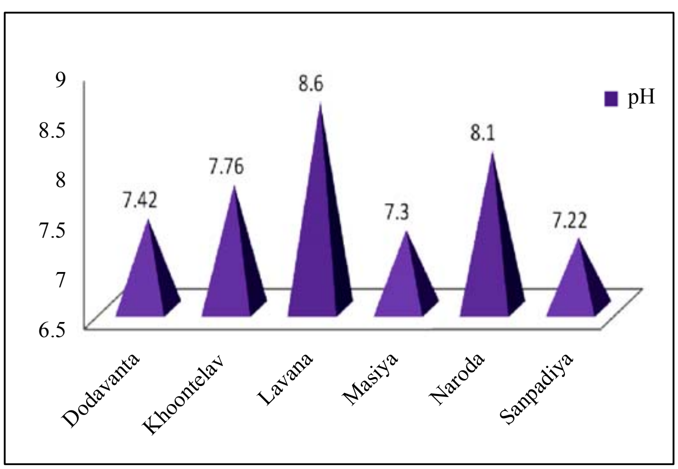

Fig. 1: pH for irrigation water of some villages of Khanpur Taluka (Gujarat)

Calculation by the usual formula

$$Ca^{2+}/Mg^{2+}\ (meq/L) = \frac{\text{Vol. of EDTA used (mL) x N x 1000}}{\text{mL of aliquot taken}}$$

CO_3^{2-} in milliequivalent per litre

$$CO_3^{2-}\ \text{in (meq/L)} = \frac{\text{Vol. of } H_2SO_4 \text{ x N x 1000}}{\text{mL of water sample}}$$

Where N = Normality of H_2SO_4

HCO_3^- in millequivalent per litre

$$HCO_3^-\ (meq/L) = \frac{\text{Normality of } H_2SO_4 \text{ x Vol. of } H_2SO_4 \text{ x N x 1000}}{\text{mL of aliquot taken}}$$

The results obtained are recorded in Table 2

Table 2: Conversion of results in (meq/L)

Villages	Ca^{2+} and Mg^{2+}	CO_3^{2-}	HCO_3^-
Dodavanta	19.6	---	5.4
Khoontelav	5.2	2.8	6.8
Lavana	3.0	2.0	9.0
Masiya	17.0	---	7.2
Naroda	15.6	---	5.2
Sanpadiya	12.0	---	7.6

RESULTS AND DISCUSSION

From the above results, it is clear that irrigation water of all the above villages are alkaline as the pH ranges from 7.5-8.6. All the waters contain Ca^{2+}, Mg^{2+} and HCO_3^-, though in different proportions. The carbonate salts are present only in the irrigation waters of Lavana and Naroda and the rest of village waters lack this constituent.

An advice may be given to the cultivator that the analysis and rating of irrigation water is not sufficient. The soil has to be analysed and the crop, which the farmer wants to grow should also be kept under consideration. Four types of rating are done at four different levels, giving weightage to four different factors: These are –

(i) Water rating according to EC. The EC reported is based on the irrigation water source (ECw) (Electrical conductivity, which is a direct function of the total soluble salts present in the sample).

(ii) According to SAR (Sodium absorption ratio an indicator of the amount of sodium in the water relative to calcium and magnesium).

(iii) Soil rating and.

(iv) Crop rating.

All these factors are individually divided into classes and the classes are numbered properly.

The water class rating is done by considering various points i.e. RSC[9] (Residual solution carbonate), which indicates and includes the data already analysed i.e.

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

Now if RSC value is less than 1.25 meq/L, the water can be safely used. The water with high RSC makes the soil infertile by depositing black alkali on the surface[10,11]. The reason being that RSC amount affects the concentration of sodium in water. If the concentration is high, it is toxic and presents the sodium hazard. In this way RSC value interprets the suitability of water.

Less than 1.25	Can be safely used
1.25-2.5	Marginal
Above 2.5	Unsuitable

The water class rating is also done considering SAR (Sodium absorption ratio)

The water class rating at EC level is also done. It indicates, though indirectly, the total amount of soluble mineral salts present in irrigation water. The high EC value is harmful for the growth of the plants physically by reducing the uptake of water. It also affects soil structure, aeration and permeability, which considerably affect plant growth and crop yield.

Thirdly, comes the soil rating, which is done in a similar manner as in the case of irrigation waters and class numbers. Last, but not least, the crops are also classified. Some crops are salt sensitive i.e. they cannot tolerate even small concentration of salts in soil or water. Some are semi-salt tolerant while still others are tolerant, as they can tolerate even high concentration of salts in soil or water.

Table 3: Classification of crops as per their tolerance of salts present in irrigation water and soils

Classification	Field crops	Fodder (forage)	Vegetables	Fruits
Sensitive	Field bean and mung	Wheat, barley, red and white clover	Onion, lemon, redish, and garlic	Pear, apple, groundnut, peach, and strawberry
Semi-salt sensitive	Maize, jowar, rice, wheat, soyaben, and arhar	Maize, cowpea, jowar, and barseen	Pea, carrot, cucumber, potato, pepper, and tomato	Grape, gauva, mango, bananas, orange, lemon, and almond
Moderately tolerant	Tobacco, mustard, oats, and maize	Pub. grass, rhodes. grass salt and grass	Pumkin, turnip, cabbage, beet, and spinach	Muskmelon, palm, coconut, and falsa

These four factors are suitably classified and the classes are numbered in a complementary way. Thus if the sum total of all these four class numbers exceeds nine, the cultivation of that particular crop in that particular soil using that particular irrigation water is declared unsuitable.

The farmer can have a preinformation regarding the harvest and can very easily prevent or check the poor yield qualitatively and quantitatively by taking suitable measures. This knowledge will help the farmer in increasing the production of agricultural goods to meet the increasing food demand for the increasing population on one hand and on the other hand, it can provide enough raw materials for various concerned industries.

CONCLUSION

Salinity is becoming a problem in many areas of Khanpur Taluka. As water quality and cropping patterns change, salinity may injure crops and reduce yield. Various crop are susceptible to salt injury. It is important that producers understand, why and how to measure salts and how crop susceptibility to salts may differ ?

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