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Study of quality parameters of Irrigation water of Jhunjhunu District and its impact on various plants and crops

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ABSTRACT

Present study is related with Khemi Sati area of Jhunjhunu district which uses industrial effluents of various industries and sewage water for irrigation purpose. Various physiological disorders are present in plants/ crops of this area to understand these disorders, quality parameters of water viz. pH, Ec, T.D.S. Total Hardness, Na^+, SAR, K^+, Cl^-, NO_3^-, SO_4^{2-}, F^- and Heavy metal analysis [Fe, Cu, Zn, Mn] is done. Study reveals that some of the parameters are higher in range than prescribed, while some are in deficient level.

Key words: Heavy metal, toxicity, deficiency, plants/crops.

INTRODUCTION

Water is the most essential thing in living system. In last few years the water pollution problem has reached a crisis point. The term pollution is defined as the deterioration in chemical, physical and biological properties of water by human and industrial activity. The Industrial wastes, sewage and agricultural run off can overload ground water with chemical wastes and nutrients and make water supply toxic[1].

Jhunjhunu district is situated in north-East Part of Rajasthan State. In South East part of district there falls a industrial area, various industries like marble, Iron, dyes etc are present, These industries pour their effluents unplanndely and the effluent through various big and small drains reaches to Khemi Sati Pond, where it got mixed with the sewage water coming from city side, Industrial effluents and sewage water through various drains reaches Khemi Sati area and finally ends up in the form of a pond. Around this pond, people are engaged in farming and they use this wastes water for irrigating fields.

No other means like tube well, hand pump present for irrigation purposes. The plants/crops growing here show early maturity, Necrosis, chlorosis, stunted growth, leaf die back etc which might be due the used of this waste water. There is a strong possibility of accumulation of heavy metals in plants/crops a large number of populations is dependent on them for their dietary purposes, so it will affect human population and make them diseased. With all this view, the recent study is done with the following objectives:-

1. Analysis of Physico-chemical parameters of industrial effluents sewage water and irrigation water.
2. Analysis of Heavy metals [Fe, Cu, Zn, Mn] in irrigation water.

EXPERIMENTAL

For the analysis of Physico-chemical parameters in water twenty five samples were collected in wide mouth plastic bottle, out of these 25 samples W_1-W_5 are of marble industry, W_6-W_{10} are of Dye Industry, W_{11}-W_{15} are of Iron industry, W_{16}-W_{20} are of Sewage water and W_{21}-W_{25} are Irrigation water. In W_{21}-W_{25} samples heavy metals [Fe, Cu, Mn, and Zn] were also done. For the analysis of Physico-Chemical parameters and Heavy metals Standard procedure was followed.[2]

RESULT AND DISCUSSION

pH

The prescribed pH range for irrigation water is 5.4 to 7.0. The analysis shows that irrigation water of area have pH value above prescribed

level, this will result in leaf chlorosis, reduced root growth, stunted shoot growth and poor flower development[3].

Ec

From the above table it is clear that effluent of marble, Iron, Sewage water and irrigation water is only suitable for soil of good Permeability; while effluent of Dye industries can only be used in soil of moderate to good Permeability[4].

T.D.S

The total dissolved solids are mainly the inorganic mineral matter and sometimes some organic large variety of slats such as chlorides, carbonates, bicarbonates, nitrates and sulphates of Ca^{+2}, Na^{+},K^{+} ,Fe^{2+} etc. Which impact total salts to water. If any one of them becomes in excess, the water is un useful for drinking and for irrigation purpose.

The tolerance limit of TDS for irrigation water is 2100 mg/l. From the above analysis it is clear that industrial effluent, sewage water and irrigation water all have low value of TDS

Total Hardness

The tolerance limit for hardness is 1300 mg/L (26 meq/L) under favourable conditions for plants. The concentration of total hardness is very low in all water of area under investigation.

Sodium (Na^{+})

The required concentration of sodium is 30 meq/L. The above analysis shows that range of sodium is suitable for irrigation purpose.

SAR (Sodium Absorption Ratio)

SAR is used as a new basis for sodicity and is calculated as

$$Na^{+}/\sqrt{Ca^{+2} + Mg^{+2}/2}$$

According to BIS, Safest limits of SAR have been recognized as 10 but this is relaxable up to 30 in most favourable conditions of plants. The value of SAR was found low in all effluents of marble, dye, Iron industries and Irrigation water, while in sewage water all the samples have high value of SAR.[5]

Potassium (K^{+})

Potassium is an essential element for plant growth. Potassium tolerance limit for irrigation water is 0.23 Meq/L to 0.75 Meq/L under favourable conditions.

From the above analysis it is clear that level of potassium in industrial effluents is not suitable for irrigation purpose as potassium is deficient, while in irrigation water, sewage water Potassium is present in Permissible limit. In deficient condition Potassium will cause yellow colour of leaves and affects, Photosynthesis process, while in toxic level it induce iron chlorosis and magnesium deficiency.[6]

Chloride (Cl^{-})

According to BIS, tolerance limit of Cl^{-} for irrigation water is 600 mg/L (17 Meq/L). Wheat, Sorghum, Cotton, barely is able to tolerate chloride in concentration from 62 to 80 Meq/L.

From the above analysis it is clear that level of chloride is very less in industrial effluents, except one sample W_{12} of iron industry, irrigation water, and sewage water, is not suitable for plants growth.

Chloride ion was found to affect Plant potentials through osmotic adjustments, such as turgor pressure, leaf water potential and osmotic potential. Influence of chloride on crop growth is hasting of maturity of small grains, Chlorosis in the younger leaves and over all wilting of the plant are the two most common symptoms of chloride deficiency[7].

Nitrates (NO_3^{-})

According to W.H.O. Permissible Concentration of nitrates is 45 Mg/L for irrigation water from the above analysis it is clear that concentration of nitrate is low in all water and is not safe for irrigation.

Sulphate (SO_4^{-2})

The BIS Prescribed 400 mg/L (12 meq/L) as Permissible limit of sulphate ion in irrigation water in absence of alternative source. Presence of Sulphate beyond limit is harmful as it directly affects the concentration of Ca^{+2} & Mg^{+2}

The concentrations of sulphate ions observed in the present study are less in range prescribed by BIS, thereby indicating that this water is not safe for irrigation[6].

Sulphate which has pronounced retarding effect on plant growth is characterized by uniformly chlorotic plant and stunted growth this seems in many plants there symptoms resemble those of nitrogen deficiencies. Sulphate does not appear to be easily translocated from older to younger plants.

Table 1: Quality Parameters of Irrigation water of Jhunjhunu District (Rajasthan)

S.No	pH	Ec	TDS	T.H.	Na^+	SAR	K^+	Cl^-	$NO3^-$	SO_4^{-2}	F^-
W_1	8.75	2.38	1523.20	395.00	19.10	9.61	0.03	10.50	4.43	3.03	0.60
W_2	8.78	2.41	1542.40	355.00	19.50	10.37	0.01	11.00	11.07	1.61	0.70
W_3	9.11	2.37	1516.80	390.00	18.30	9.20	0.13	10.00	8.86	8.33	0.70
W_4	9.31	2.34	1497.60	390.00	23.00	11.67	0.18	10.00	11.07	12.48	0.80
W_5	9.28	2.27	1452.80	355.00	24.70	13.13	0.18	10.50	8.86	8.98	0.80
W_6	7.80	2.72	1100.80	495.00	12.40	5.58	0.12	12.20	4.43	0.12	2.80
W_7	7.90	1.80	1152.00	465.00	13.00	6.04	0.22	13.50	6.64	-0.38	3.00
W_8	7.80	1.79	1145.60	450.00	12.30	5.80	0.18	12.00	6.64	-0.12	3.20
W_9	8.10	1.65	1056.00	490.00	12.70	5.74	0.10	12.10	8.86	0.70	3.20
W_{10}	8.30	1.78	1139.20	480.00	14.10	6.43	0.21	10.00	6.64	3.31	4.20
W_{11}	8.50	2.45	1568.00	355.00	18.20	9.68	0.12	14.20	8.86	0.32	3.80
W_{12}	8.50	2.59	1657.60	360.00	18.40	9.73	0.13	18.30	11.07	-3.87	3.00
W_{13}	8.40	2.30	1472.00	355.00	18.50	10.39	0.15	10.00	15.50	2.34	3.20
W_{14}	8.30	2.30	1472.00	355.00	18.00	9.57	0.14	12.00	8.86	2.64	4.40
W_{15}	8.00	2.33	1491.20	375.00	20.00	10.36	0.14	10.00	6.64	4.04	5.00
W_{16}	7.71	2.75	1760.00	285.00	19.10	11.16	0.13	7.00	8.86	12.03	2.50
W_{17}	8.11	2.78	1779.00	285.00	19.50	11.60	0.10	8.00	13.39	8.80	2.00
W_{18}	8.41	2.68	1715.00	292.00	18.30	10.76	0.26	7.00	19.93	6.90	3.50
W_{19}	8.94	2.62	1676.00	280.00	23.00	13.77	0.18	10.00	17.72	6.28	4.30
W_{20}	8.68	2.78	1779.00	290.00	24.70	14.52	0.07	10.00	15.50	9.57	3.20
W_{21}	8.86	2.60	1664.00	410.00	23.25	12.10	0.24	14.00	12.84	8.89	2.60
W_{22}	8.70	2.78	1702.00	433.00	22.75	11.78	0.27	12.25	19.49	10.47	2.40
W_{23}	9.10	2.90	1779.20	422.00	23.50	11.98	0.23	14.50	16.83	8.83	3.00
W_{24}	9.15	2.85	1824.00	398.00	23.10	11.72	0.29	15.00	13.29	8.37	3.30
W_{25}	9.22	2.72	1740.00	418.00	22.60	11.30	0.25	14.40	15.94	8.59	4.20

W_1-W_5 is of marble industry, W_6-W_{10} is of Dye Industry, W_{11}-W_{15} is of Iron industry, W_{16}-W_{20} is of Sewage water and W_{21}-W_{25} is of Irrigation Water.
* Na^+, K^+, Cl^-, $SO_4^{2-}$are in meq/l; ** TDS, NO_3^-, F^- , Total Hardness is in ppm; *** Ec is in mmho/cm.

Fluoride [F^-]

Fluoride is an essential nutrient for plant growth. Fluoride tolerance limit for irrigation water is 1.5 Mg/L. From the above anlysis it is clear that except marble industry all the water have toxic range of fluoride.

Iron (Fe)

Iron is very important element for normal metabolism of plant and animals; it is a constituent of cytochrome and non human iron protein involved in photosynthesis, N_2 Fixation and respiratory linked dehydrogenases. The analyzed irrigation water has iron range 3.80 to 4.00 ppm, which shows that plant/crops grown with this water will be iron deficient. A deficiency of iron show up first in the young leaves of plant. It does not appear to be translocated from older tissues to the meristem and a result growth ceases, the young leaves develop an interveinal chlorosis, which progresses rapidly over the entire

Table 2: Heavy Metal analysis in Irrigation Water of Jhunjhunu district (Rajasthan)

S.No.	Iron (Fe) ppm	Copper (Cu) ppm	Zinc (Zn) ppm	Manganese (Mn) ppm
W_{21}	3.90	3.50	2.10	4.40
W_{22}	4.00	3.90	2.00	4.10
W_{23}	3.80	4.00	2.10	4.10
W_{24}	3.90	3.80	2.20	4.20
W_{25}	3.92	3.50	2.00	4.10

leaf. In severe conditions over the leaves turn, entirely white.

Copper [Cu]

Copper is essential element in irrigation water. The standard Cu range for irrigation water should be from 0.12 to 3 Mg/L for plant. In the irrigation water sample analyzed No. W_1 to W_5 have Cu range for 3.50 to 4.00 Mg/L. It is toxic and unsuitable for optimal growth of plant.

The most common toxicity symptoms include growth poorly developed or malformed roots system and leaf chlorosis. The basic effect of Cu in related to the root system where it interferes with enzyme functioning. It also interferes with Photosynthesis and fatty acid synthesis. Though copper have been reported in numerous plants although it is more prevalent among crops growing in peat and musk soils, crops most susceptible to copper higher concentration includes alfalfa wheat, barely oats, lettuce, onions carrot, spinach, and table beets.

Zinc (Zn)

Zinc is essential elements for plants growth. Plant requires 0.3 ppm zinc in irrigation water for their healthy growth but the analyzed samples have zinc in 2.00 to 2.20 ppm range which shows that plants will show toxic effect zinc. At higher concentration, it disturbs photosynthesis process.

Manganese (Mn)

Manganese is another of the transition metals required as a micronutrient. Manganese is essential elements for plant growth and animals. It is required for activity of some dehydrogenises, decarboxylases, Kinases oxidases, peroxidases etc. Manganese tolerance limit for Irrigation is 0.2 to 2.5 ppm, the Mn range in irrigation water sample No. W_1 to W_5 is 4.10 ppm to 4.40 ppm. This shows higher manganese in the area under investigation. Manganese is required for photosynthesis and evolution of oxygen. This metal is not a serious pollutants as in most water its concentration is quite low.

The main role of Mn in plant is as an activator of enzyme associated with phosphorous reaction with the plant energy system.Mn is effective in promoting enzyme transformation.

Manganese influences auxin levels in plants and it seems that high concentration of this micronutrient favour the breakdown of indolacetic acid. Plants are injured by excessive amounts of Mn [7].

In the above study it is concluded that irrigation water of Khemi Sati area is unfit for irrigation. If irrigation with this water continuous it will continue to affects plant and animal, and may cause land to become barren. So this water should be used after proper treatment.

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REFERENCES

1. R.S. Lokande and Sathe C.W. *Asian Journal of Chemistry,* **13**(1): P-190 (2001).
2. S. Gupta, *Current world environ.* **2**(1): P-89 (2007).
3. N. Zieslin : ISHS Acta Horticulture 361: International Symposium on New Cultivation System on green house.
4. Rashmi Jain, M. phill dissertation submitted to M.D.S. University Ajmer, P-37 (2001).
5. Mridula Bhatnagar and Suruchi Gupta : *Asian Journal of Chemistry,* **13**(4): P-1405 (2001).
6. S. Gupta and Ajay Singh Solanki: 34th Conference of Rajasthan. Geographer association held at Bikaner (2006).
7. Samuel T. Tisdale, Werner I. Nelson, James D Beaton : Soil Fertility and Fertilizers, 4th Edn ; Macmillan Publishing Company, New York (1990).