*The Journal of Rural and Agricultural Research Vol. 21 No. 2, 38-41 (2021)*
*Received July 2021; Acceptance November 2021*

# Quality of sewage irrigation water of Agra Municipal area

NIDHI NAGAR, VIPIN KUMAR, R.B. SINGH[4], DEVENDRA PAL[1], B.S. KHERAWAT[2], JULERI M. UPENDRA[3], MUNNA LAL[3] AND P.K. SHISHODIA[4]
*Department of Agricultural Chemistry & Soil Science, R.B.S College, Bichpuri, Agra,India*

**Abstract**

*An assessment of the quality of sewage irrigation water is very important in the arid and semi-arid regions of the country where the quality of sewage irrigation water is questionable and possesses the serious problem of salinity. With this view, the present investigation was undertaken to evaluate the quality of sewage irrigation water as per cationic and anionic composition along with the relationship between various sewage irrigation water quality indices of the Agra municipal area. To achieve the objectives, a sewage irrigation water quality survey was conducted in three sites spread all over Agra municipal area. Total in seventy-five sewage irrigation water samples was collected from different locations representing each site to A (25), B (25), and C (25). The present investigation leads to conclude that majority (33.3 percent) of sewage irrigation waters of Agra municipal area are having electrical conductivity up to 3.0 m mhos $cm^{-1}$. The sewage irrigation waters which are likely to cause RSC problems (RSC 1.25 to 2.50 and RSC 72.50) were 72.0 percent.*

**Keywords:** Sewage water, water quality, irrigation

## Introduction

Sewage has important components- water, plant nutrients, and organic matter, which are broadly required in Indian agriculture. There is a scope for further expansion of sewage farming programs now, and in the future, more cities will be provided with drainage systems. Besides the necessity of sewage farming farm point of view of the utilization of the resources, it is also an effective method to avoid pollution. Unrestricted discharge of city liquid wastes in rivers and streams and land results in pollution of the environment and has a very strong impact on the quality of human and animal life and creates strong health hazards. The present utilization of wastewaters is only about 31 percent of the total potential. The average N, P, K content of Indian city sewage is 50 ppm N, 15 ppm $P_2O_5$, and 30 ppm $K_2O$. Sewage sludge could form an important component of composting. During the last couple of decades, land application wastewater is being re-emphasized as an alternative technology for waste treatment. The hydraulic and nutrient loading in different sewage farms in India varies from 22 to 340 m/ha/year and 400 to 6000 kg/ha/year, respectively. Thus, the present-day system is inclined towards the disposal of sewage rather than appropriate nutrient management. The organic and inorganic loading is also increasing beyond the assimilation capacity of the soil. The excessive N-loading induces more foliage and creates an imbalance in the C/N ratio of the soil. The application of industrial effluents to soil is governed primarily by the nature of its constituents. For example, toxic elements present in industrial effluents when applied to agricultural lands may enter the food chain. These may also leach to groundwater or reach surface waters through runoff and deteriorate their quality. For allowing the wastewater to be cleaned by percolation through soil or dumping the sewage sludge on agricultural lands, it must be ensured that these do not leave undesirable residues in the soil. In this regard, the characteristics of wastes assume great importance.

[1]Krishi Vigyan Kendra Sambhal (SVPUA& T Meerut) UP
[2]KVK, Bikaner-II, Swami Keshwanand Rajasthan Agricultural University, Bikaner, Rajasthan,
[3]ICAR-CRIDA Santosh Nagar, Hyderabad-59
[4]AICRP salinity project, R.B.S College, Bichpuri,Agra

## Materials and Methods

The investigation was conducted at the Department of Agricultural Chemistry and Soil Science, R.B.S. College, Bichpuri, Agra in the year 2002-2003. The irrigation water samples were collected and analyzed for their chemical characteristics to assess their suitability for irrigation use. The Agra municipal area lies more in the center of the upper Yamuna River do a bordering the district Firozabad and Etawah in the east and Rajasthan in the west, and Mathura and Firozabad in north and Rajasthan and Madhya Pradesh in the south. A survey of sewage irrigation water was conducted in three areas of Agra Municipal Corporation and seventy-five (75) water samples were collected at three sites A) Chaudhary Farm, Kheria Chauraha, B) Opposite Hotel Deedar-e-Taj, Fatehabad Road, and C) Near Sewer water discharge tubewell, Fatehabad roadin between 5th or 6th September 2002. All the water samples were taken from the sewage water supply for irrigation in these areas.

## Results and Discussion

The data regarding the mean chemical composition along with their site-wise, maximum, minimum, and average values of different chemical characteristics of sewage irrigation water of Agra municipal area are presented in Table 1. The pH value of the waters analyzed, varied in the range of 7.2 to 9.4 with an average of 8.6 which indicates that the waters are saline. The electrical conductivity of irrigation water ranged from 1.2 to 3.4 mili mhos cm-1 with an average value of 1.8 m mhos $cm^{-1}$ (Table 1). The average value of the electrical conductivity indicates that the salinity problem in these waters is not so high. In site- The EC is more than site B and C 33.3% of waters fall in EC range 3.0 to 3.4 m mhos $cm^{-1}$ and 66.7% waterfall in the range of 1.2 to 1.3 m mhos $cm^{-1}$ EC All these waters are in common use for raising the crops in the municipal area. The pH, EC, and water quality parameters remained well within the normal limits of irrigation water. These findings are following the findings reported by Chandrasekaran et al. (2003). Similar findings have shown out sewage effluent was alkaline in reaction (pH-8.3) andnon-saline (EC 1.1 to 1.5 $dsm^{-1}$) it is conducted in Madurai, Tamil Nadu, India. (Malarvizhi and Rajamannar (2001). The distribution of sewage irrigation water samples in different salinity classes has been presented in table 1. The data indicate that sites B and C fall in the same classes while site A in the higher class to B and C sites. In the Agra region salinity of underground irrigation water increased towards the western direction which is also the direction of increasing aridity. Waters of the Agra region are characterized by much higher salinity (Narain et al. 1978).

The distribution of calcium over magnesium in sewage irrigation water had the average Mg/ Ca ratio of sites A, B & C between 1.04, 1.466 and 1.34 respectively. Agra municipal area site-wise distribution of water sample concerning Mg / Ca ratio have been presented in Table 2. The distribution indicates that only in site A calcium dominates over magnesium. In the rest of the water site (B and C) calcium and magnesium distribution are approximately the same.

Table 1: Mean chemical composition of sewage irrigation water samples of Agra municipal area

| Sample No. & Name | Mean | EC ($dSm^{-1}$) | pH | Cations ($m.e.l^{-1}$) | | | | Anions ($m.e.l^{-1}$) | | | RSC | SAR | SSP | Mg/Ca |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | $Ca^{++}$ | $Mg^{++}$ | $Na^{+}$ | $K^{+}$ | $CO_3$ | $HCO_3$ | $Cl^{-}$ | | | | |
| Site-A25Samples | Max. | 3.4 | 8.9 | 7.2 | 9.8 | 34.7 | 2.8 | 8.0 | 8.0 | 25.2 | -0.6 | 12.8 | 67.3 | 1.6 |
| | Min. | 3.0 | 7.2 | 5.8 | 7.6 | 16.9 | 1.2 | 4.0 | 1.0 | 24.2 | -10.2 | 6.1 | 50.9 | 1.0 |
| | Avg. | 3.2 | 8.0 | 6.3 | 8.5 | 21.3 | 1.5 | 4.8 | 5.3 | 24.5 | -4.4 | 7.8 | 57.5 | 1.3 |
| Site-B25Samples | Max. | 1.3 | 9.1 | 3.8 | 4.6 | 8.2 | 6.1 | 8.0 | 8.0 | 9.2 | +5.4 | 4.1 | 49.0 | 1.9 |
| | Min. | 1.2 | 7.9 | 2.4 | 2.4 | 5.2 | 0.7 | 4.0 | 2.0 | 8.2 | +0.2 | 2.8 | 34.0 | 0.6 |
| | Avg. | 1.2 | 8.7 | 3.2 | 3.3 | 6.1 | 2.8 | 4.1 | 4.6 | 8.7 | +2.3 | 3.4 | 40.2 | 1.0 |
| Site-C25 Samples | Max. | 1.3 | 8.9 | 3.6 | 4.4 | 39.5 | 4.8 | 8.0 | 6.0 | 9.4 | +4.0 | 22.2 | 79.0 | 2.2 |
| | Min. | 1.2 | 7.7 | 2.0 | 3.6 | 13.9 | 3.8 | 4.0 | 2.0 | 8.0 | +1.0 | 7.8 | 55.2 | 0.7 |
| | Avg. | 1.2 | 8.6 | 3.2 | 3.2 | 20.9 | 4.4 | 4.1 | 4.8 | 8.8 | +2.6 | 11.7 | 64.8 | 1.0 |
| Overall | Max. | 3.4 | 9.1 | 7.2 | 9.8 | 39.5 | 6.1 | 4.8 | 5.3 | 24.7 | +5.4 | 22.2 | 79.0 | 2.20 |
| | Min. | 1.2 | 7.2 | 2.0 | 2.4 | 5.2 | 0.7 | - | 4.6 | 8.7 | -10.2 | 2.8 | 34.0 | 0.60 |
| | Avg. | 1.8 | 8.4 | 4.2 | 5.0 | 16.1 | 2.9 | * | 4.9 | 14.0 | +0.167 | 7.6 | 54.2 | 1.10 |

Regarding the Mg/Ca ratio, 30.6% waters are in the range of <1, 68.0% in 1 -2 and only 1.4% in 2-3 Mg/Ca ratio.

Table 2: Site-wise distribution of sewage irrigation water samples in different salinity classes

| S.No. | Site | Total Samples | No. of samples in each EC class 0-1 | 1-2 | 2-3 | 3-4 |
|---|---|---|---|---|---|---|
| 1. | A | 25 | — | — | — | 25 |
| 2. | B | 25 | — | 25 | — | — |
| 3. | C | 25 | — | 25 | — | — |
| | Total | | — | 50 | — | 25 |

Total Ca++ and Mg++ contents ranged from 18-292 and 19- 134 ppm in the sewage effluent collected from Madurai, Tamilnadu (Malarvizhi and Rajamannar 2001). The sodium adsorption ratio in sewage irrigation water of Agra municipal area ranges from 2.8 to 22.2 having an average value of 7.6 (Table 4). Distribution of irrigation water samples of different sites concerning SAR classes has been presented in Show that the (table 5) 80 % samples had SAR value < 10 are in the group S1 18.6% in S2 class (10-18) and 1.33 % waters in S3 class (18-26). The maximum number of 100% water of site B had SAR values < 10 while site A and B had SAR 96 and 44% respectively.

The site-wise distribution of sewage water samples concerning SSP classes, Data in the table 6 indicates that 73.3% of waters had SSP<60 which is a permissible limit for the use of the waters according to the SSP standard (Wilcox 1948). About 26 % of waters fall in class 60-80 SSP designated as a doubtful category. The majority of waters of the Agra region are safe from sodium hazards (Tripathi et al. 1969). A perusal of the data indicates that 100% sewage waters of site B 80% waters of site A and 48 % of waters of site C were under the permissible limit of <60 of SSP while 60% of sewage irrigation waters of site C and 20% waters of site A had SSP in between 60-80 designated as a doubtful category.

Residual sodium carbonate of sewage irrigation waters ranges from -10.2 to 5.4 with an average value of 0.167 (Table 7) while its distribution in the waters of different sites has been presented in Table 8. That the 33.3 percent of sewage irrigation waters had negative RSC and 66.7% of water was characterized as RSC positive. Further, out of positive RSC water samples, 5.33 percent were safe (RSC>1.25),33.3 percent marginal (RSC 1.25-2.5), and 28 percent unsafe (RSC>2.5) concerning RSC standard. Similar findings have also been reported by Narain et al. (1976) regarding the irrigation waters of this area.

Table 3: Average chemical composition of sewage irrigation water concerning Electrical Conductivity (EC)

| EC ($dSm^{-1}$) | Total Samples | EC ($dSm^{-1}$) | pH | Cations ($meq.l^{-1}$) $Ca^{++}$ | $Mg^{++}$ | $Na^{+}$ | $K^{+}$ | Anions ($meql^{-1}$) CO3 | HCO3 | $Cl^{-}$ | RSC | SAR | SSP | Mg/Ca |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0-1 | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| 1-2 | 50 | 1.25 | 8.66 | 3.21 | 3.24 | 13.55 | 3.62 | 4.16 | 4.76 | 8.84 | 2.47 | 7.55 | 52.49 | 1.04 |
| 2-3 | 1 | 3.0 | 8.4 | 6.0 | 8.8 | 18.2 | 1.538 | 8 | 4 | 24.4 | -2.8 | 6.69 | 52.69 | 1.466 |
| 3-4 | 24 | 3.27 | 7.9 | 6.36 | 8.49 | 21.48 | 1.53 | 4.66 | 5.33 | 24.55 | -0.46 | 7.89 | 57.69 | 1.34 |

Table 4: Site-wise distribution of sewage irrigation water samples concerning Mg/Ca ratio

| S. No | Site | No. of samples | No of samples in each Mg/Ca ratio <1 | 1-2 | 2-3 | 3-4 |
|---|---|---|---|---|---|---|
| 1 | A | 25 | - | 25 | - | - |
| 2 | B | 25 | 12 | 13 | - | - |
| 3 | C | 25 | 11 | 13 | 1 | - |
| | Total | 75 | 23 | 51 | 1 | - |

Table 5: Site-wise distribution of sewage irrigation water samples concerning SAR classes

| Site | No. of samples | No of samples in each SAR class <10 | 10-18 | 18-26 | >26 |
|---|---|---|---|---|---|
| A | 25 | 24 | 1 | - | - |
| B | 25 | 25 | - | - | - |
| C | 25 | 11 | 13 | 1 | - |
| Total | 75 | 60 | 14 | 1 | 0 |

*Relationship between different chemical characteristics of sewage irrigation water*

The correlation coefficient between different chemical characteristics of sewage irrigation waters has been given in Table 9. Data indicate a significant positive correlation between EC vs. Mg/Ca and a non-

Table 6: Site-wise distribution of sewage irrigation water samples with respect to SAR classes

| Site | No. of samples | No of samples in each SAR class <10 | 10-18 | 18-26 | >26 |
|---|---|---|---|---|---|
| A | 25 | 24 | 1 | - | - |
| B | 25 | 25 | - | - | - |
| C | 25 | 11 | 13 | 1 | - |
| Total | 75 | 60 | 14 | 1 | 0 |

Table 7: Site-wise distribution of sewage irrigation water samples concerning SSP classes

| Site | No. of samples | No of samples in each Mg/Ca ratio <20 | 20-40 | 40-60 | 60-80 | >80 |
|---|---|---|---|---|---|---|
| A | 25 | - | - | 20 | 5 | - |
| B | 25 | - | 13 | 12 | - | - |
| C | 25 | - | - | 10 | 15 | - |
| Total | 75 | - | 13 | 42 | 20 | 0 |

Table 8: Site–wise distribution of sewage irrigation water sample concerning RSC ($meql^{-1}$) classes

| Site | No. of samples | No of samples in each RSC class Negative | Positive 0-1.25 | 1.25-2.5 | >2.5 |
|---|---|---|---|---|---|
| A | 25 | 25 | - | - | - |
| B | 25 | - | 2 | 16 | 7 |
| C | 25 | - | 2 | 9 | 14 |
| Total | 75 | 25 | 4 | 25 | 21 |

Table 9: Correlation between different properties of sewage irrigation water of Agra municipal area

| S. No. | Property X vs. Y | Correlation (r) |
|---|---|---|
| 1 | EC Vs pH | -0.6365 |
| 2 | EC Vs Mg/Ca | 0.522* |
| 3 | EC Vs SAR | 0.036 NS |
| 4 | EC Vs SSP | 0.201 NS |
| 5 | EC Vs RSC | -0.864* |

*= Significant at 5% level NS= Non-significant

significant positive correlation between EC vs SAR and SSP. Non- significant positive correlations in EC vs SAR have also been reported by Singh and Narain (1979) & Mandal and Jain (1966). Electrical conductivity was found to be negatively correlated with pH and Residual Sodium Carbonate(RSC)of irrigation waters under study.

## References

Chandrasekaran, N and Rajkaran, B. (2003). Nature and Characteristics ofsewage effluents of Tamilnadu. Madras Agric. J.90(1-3): 124-128.

Handa, B.K (1981). An integrated water quality index for irrigation use. Indian J. Agric. Sci.31:422-426.

Malarvizhi, P. and Rajamannar, A. (2001). Soil fertility management in fodder cultivated area through sewage.

Richards, L.A. (1954). Diagnosis and improvement of saline and alkali soils. U.S.D.A. Hand Book No. 60.

Shrabani, S.; Gupta, S.K. and Banerjee, S.K. (1994). Assessment of the quality of sewage effluents from Howrah sewage treatment plant Journal of Indian Society of Soil Science. 42(4): 571-575; 12 ref.