www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277-7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2023; 12(6): 467-469

www.thepharmajournal.com
Received: 08-03-2023
Accepted: 13-04-2023

VN Ghorpade
Assistant Professor, Division of Soil Science, College of Agriculture (MPKV), Pune, Maharashtra, India

SU Dehmukh
Assistant Professor, Division of Soil Science, College of Agriculture (MPKV), Pune, Maharashtra, India

AB Jadhav
Assistant Professor, Division of Soil Science, College of Agriculture (MPKV), Pune, Maharashtra, India

DD Sawale
Soil Lab Analyst Scheme, Division of Soil Science, College of Agriculture (MPKV), Pune, Maharashtra, India

Corresponding Author:
VN Ghorpade
Assistant Professor, Division of Soil Science, College of Agriculture (MPKV), Pune, Maharashtra, India

Assessment of irrigation water quality in Pune region

VN Ghorpade, SU Dehmukh, AB Jadhav and DD Sawale

Abstract
The experiment was conducted to "assess the quality of irrigation water in Pune region" from 2019-2021 under Soil Lab Analyst Scheme, Division of Soil Science and Agricultural Chemistry, College of Agriculture, Pune. Total fifty two irrigation water samples were collected from different sources viz., bore well (29), well (13), lift on canal/river (7) and farm pond (3) and assessed the quality. These samples were analysed for EC, SAR (sodium adsorption rato), RSC (Residual Sodium Carbonate), Mg: Ca ratio, Kelly's ratio and permeability index for its suitability of irrigation.
It was observed that 9 (31.02%), 2 (15.38%) and 1(33.34%) samples were found in unsuitable category for electrical conductivity of bore well water, well water and farm pond respectively. However remaining samples were found in low to moderate category. In case of SAR all the samples collected from different sources were found in the low category except 3 (10.34%) samples from bore well recorded more than 26 SAR. However 20 to 28 percent samples were found unsuitable for RSC in case of bore well water, well water and farm pond respectively. Similar trend was also reported for Mg: Ca ratio for bore well water, well water and farm pond by reporting almost 44.82 to 57.14 % samples were in unsuitable category. Kelly's ratio (indicates dispersion/ aggregation index) was almost less than 1 for all the irrigation water sources except bore well. Internal movement of irrigation water was interpreted by using permeability index. Among different sources 6.90 to 42.85 % samples were in unsuitable category from bore well, well, river/canal lift irrigation water. It could be concluded from the analytical data of irrigation water collected from bore well and well was found unsuitable for irrigation on fine textured soil than river/canal lift irrigation water.

Keywords: Irrigation water quality, SAR, RSC

Introduction
Water is the most important input required for increasing agriculture production and maintaining the soil health. But in the back drop of this grim water scenario, the agriculture sector would be left with no other alternative than to use poor quality water sources to meet the irrigation requirements. The quality of water is an important consideration in an irrigated area. Water is one of the most essential substance on the earth which is necessary to maintain the life on the earth (Meena, *et al*., 2020) [1].
Indiscriminate use of poor quality water for irrigating agricultural crops deteriorates the productivity of soils through salinity, Sodicity and toxic effects of salts. In addition to reduced productivity, the use of poor quality water deteriorates the quality of produce and also limits the choice of cultivable crops. (Minhas., 1996) [2].
Rainfall plays an active role for changing the water quality of underground aquifers (Kaushik *et. al*., 2002) [3]. This poor quality is available mainly in canal region or in command of big irrigation projects (Bhakare and Nikam., 2012) [4]. The well water quality is also affected predominantly by canal, seepage of rain water and excess use of irrigation water etc. (Sugirtharam *et al*. 2008). However, the assured supply of good quality irrigation water is one of the important factor for increasing agricultural production.

Material and Methods
Total fifty two (52) irrigation water samples of Pune region were collected from different sources viz., bore well (29), well (13), lift on canal/river (7) and farm pond (3) to assess the quality. Chemical analysis for different cations and anaions viz., (CO_3^{2-}, HCO_3^-, Cl^-, SO_4^{2-}, Ca^{2+}, Mg^{2+}, Na^+ and K^+) as well as total concentration of soluble salts (EC) and pH was analysed by using standard methods. There are some derived parameters based on the calculations. Cations and anions in irrigation water are used for assessing the sodium absorption raio (SAR), residual sodium carbonate (RSC), Mg/Ca ratio, Kelley's ratio and permeability index etc.

Combined effect of electrical conductivity and sodium adsorption ratio were suggested by United States Department of Agriculture (USDA). Water quality is categorized into 16 classes with the different combination of electrical conductivity (EC× 10^6 at 25 °C in micromhos/cm) and sodium adsorption ratio (SAR) to analyze the suitability of water for irrigation purpose. Salinity hazard is categorized as low salinity hazard (C1), medium salinity hazard (C2),high salinity hazard (C3) and very high salinity hazard (C4) while sodium hazard is categorized as low sodium hazard (S1), medium sodium hazard (S2), high sodium hazard (S3) and very high sodium hazard (S4),

Criteria for classification of irrigation water samples have given below

Table 1: Criteria to classify the irrigation water samples

Sr. No.	Parameters	Formula	Range	Water quality
1	EC (µmhos/cm) (Richard, USDA, 1954)	-	<250 250-750 750-2250 >2250	Excellent/Low salinity hazard Good/Medium salinity hazard Doubtful/High salinity hazard Unsuitable/Very high salinity hazard
2.	Sodium Absorption Ratio (SAR) (Richard, USDA, 1954)	Na^+ $Ca^{2+} + Mg^{2+}$ 2	<10 10-18 18-26 >26	Excellent/Low sodium hazard Good/Medium sodium hazard Doubtful/High sodium hazard Unsuitable/Very high sodium hazard
3.	Residual Sodium Carbonate (meq/l) (RSC) (Richard, USDA, 1954)	$(CO_3^{2-}+HCO_3^-) - (Ca^{2+} + Mg^{2+})$	< 1.25 1.25-2.50 >2.50	Safe Moderate/Marginal Unsuitable
4.	Mg: Ca ratio	----	< 1.25 >1.25	Suitable Unsuitable
5.	Kelly's Ratio (Kelly, 1940 & 1963	Na^+ $(Ca^{2+} + Mg^{2+})$	< 1 >1	Safe/ Suitable Unsafe/ Unsuitable
6.	Permeability Index		>75 25-75 <25	Suitable Good Unsuitable

Results and Discussion

Electrical Conductivity (EC)

The most important water quality guideline on crop productivity is the water salinity hazards as measured by electrical conductivity. High EC in water lead to physiological drought which make less availability of water to plants even soil seems wet. This physiological drought reduces the yield. Water samples have exhibited high EC, which shows high concentration of salts in water (Wilcox, 1955) [10]. It was observed that EC of maximum number of samples from all irrigation sources is in moderate category. Out of 52 samples 9 water samples categorized under excellent quality group, 31 samples were having good quality and 12 samples were found unsuitable for irrigation. Among different irrigation sources *viz.* bore well, well, river/canal lift and farm pond 31.03 percent bore well samples are unsuitable for irrigation.

Table 2: Classification of irrigation water samples from different sources based on their Suitability

Sr. No	Parameter	Bore well water (29)	Well water (13)	River/canal lift (7)	Farm Pond (3)
1	**Electrical Conductivity**				
	Low (< 0.25 dS/m)	4 (13.79)	2 (15.38)	3 (42.86)	0
	Moderate (0.25-2.50 dS/m)	16 (55.17)	9 (69.23)	4 (57.14)	2 (66.66)
	Unsuitable (> 2.50 dS/m)	9 (31.03)	2 (15.38)	---	1 (33.34)
2	**Sodium adsorption ratio (SAR)**				
	Low (< 10)	26 (89.66)	13 (100)	7 (100)	4 (100)
	Moderate (10-26)	---	---	---	---
	High (>26)	3 (10.34)	---	---	---
3	**Residual Sodium Carbonate (RSC)**				
	Low (< 1.25 meq/lit)	18 (62.06)	8(61.53)	4 (71.43)	3 (100)
	Moderate (1.25-2.50 meq/lit)	5 (17.24)	2 (15.38)	---	---
	Unsuitable (> 2.50 meq/lit)	6 (20.68)	3 (23.08)	2 (28.57)	---
4	**Mg: Ca**				
	Suitable (<1.25)	16 (55.17)	7 (53.85)	4 (42.86)	3 (100)
	Unsuitable (>1.25)	13 (44.82)	6 (46.15)	3 (57.14)	
5	**Kelley's ratio**				
	Suitable (< 1)	25 (86.21)	12 (92.31)	7 (100)	2 (66.66)
	Unsuitable (> 1)	4 (13.79)	1 (7.69)	---	1 (33.34)
6	**Permeability index**				
	Suitable (>75)	7 (24.13)	1 (7.69)	1 (14.29)	1 (33.34)
	Good (25-75)	20 (68.97)	10 (76.92)	3 (42.85)	2 (66.66)
	Unsuitable (<25)	2 (6.90)	2 (15.38)	3 (42.85)	

Figures in bracket indicates percentage value

Sodium Absorption Ratio (SAR)
Sodium absorption ratio indicates the ability of sodium ions to replace the calcium and magnesium ions from soil. High concentration of sodium is undesirable in water because sodium adsorbs onto the soil cations exchange sites, causing soil aggregates to breakdown sealing the pores of the soil and making it impossible to water flow. This rearranges the soil particles and reduces the pore size which makes less infiltration to water to reach the roots of plants. (Pck, Tom. 2011) [8]. Out of 52 samples 49 samples i.e. 95% have found excellent on the basis of sodium absorption ratio. Only 3 samples of bore well were found unsuitable according to SAR.

Residual Sodium Carbonate (RSC)
Residual Sodium Carbonate indicates the dominance of carbonate and bicarbonate over the concentration of calcium and magnesium. High concentration of carbonates precipitates the calcium and magnesium which give back stain on drying (Richard, 1954) [6]. On the basis of RSC 63 % samples were found safe, 13% moderately safe and 21% samples were found unsuitable for irrigation.

Kelley's Ratio
Kelly's ratio is the ratio of sodium to calcium and magnesium (Rawat *et al*, 2018) [9]. 90% samples were found suitable and 10% samples found unsuitable for irrigation from the different irrigation sources *viz.*, bore well, river, well and farm pond.

Permeability Index
Permeability index shows the rate of infiltration. Most of the irrigation water samples are good for irrigation on the basis of permeability index.

Conclusion
It is concluded that most of the bore well samples have high salinity hazard but having low sodium hazard. The samples collected from open well water most of the samples are suitable for irrigation with low sodium hazard. While samples collected from farm pond are moderately suitable with some management practices.

References
1. Meena, Arjun Lal, Bisht, Priyanka. Assessment of quality of portable water in Bassi Tehsil, Jaipur district, Rajasthan, India. Our Heritage. 2020;68(30):8593-8607.
2. Minhas PS. Saline water management for irrigation in India. Agricultural water management. 1996;30:1-24.
3. Kaushik A, Kumar K, Sharma IS, Sharma HR. Groundwater quality assessment in different land use areas of Rohtak and Faridabad cities of Haryana using deviation index. Journal of environmental Biology. 2002;25:173-180.
4. Bhakare BD, Nikam. Seepage prone well water suitability for irrigation in Mulaleft bank canal Agropedology. 2012;5(2):88-95.
5. Sungirtharam M, Bhakare BD, Pawar DD. Changes in well water quality with distance from the Mula right bank canal of Rahuri tehsil, Maharashtra, India. Journal of Indian Society of Soil Science. 2008;5:9-18.
6. Richards LA. Diagnosis and improvement of saline and alkali soils. United States Department of Agriculture; c1954. p. 60.
7. Kelly WP. Permissible composition and concentration of irrigation water. Proceedings of the American society of civil engineers. 1940;66:607-613.
8. Pick, Tom. Assessing water quality for human consumption, agriculture and aquatic life uses. United states department of agriculture. Natural resources conservation service. Environment technical note. MT-1 (Rev.2); c2011. p. 17.
9. Rawat, Kishan R, Singh, Sudhir Kumar, Gautam, Sandeep Kumar. Assessment of groundwater quality for irrigation use: A peninsular case study. Applied water science. 2018;8:233.
10. Wilcox LY. Classification and use of irrigation water. united states department of agriculture; c1955. p. 969.