



ASSESSMENT OF QUALITY OF IRRIGATION WATER USED FOR GRAPE GARDENS IN WESTERN MAHARASHTRA

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Abstract: The present investigations was conducted at division of Soil Science and Agricultural Chemistry, College of Agriculture, Pune and Maharashtra Draksh Bagayatdar Sangh (M.R.D.B.S.), Manjri, Pune during 2013-14. The study consists of comparison in the quality of irrigation water in four grape growing regions viz; Pune, Nashik, Sangli and Solapur of Western Maharashtra. The region wise irrigation water samples either from well, bore well or canal were collected. Irrigation water quality data of 505 samples during 2007-08 were considered as baseline in this study. The number of irrigation water samples were collected from Pune 104, Nashik 34, Sangli 51 and Solapur 123 in the year 2013-14. The irrigation water samples were analyzed for pH, electrical conductivity, content of cations, anions and boron. The irrigation water quality parameters like EC, SAR and RSC were higher in the year 2013-14 as compared to 2007-08 in Sangli region. The pH and SO_4^{2-} concentration in irrigation water were higher in Solapur region during 2013-14 as compared to 2007-08. The potassium and boron concentration in irrigation water were higher in Pune region in 2013-14 as compared to 2007-08. The nitrate nitrogen, Mg:Ca ratio and Kelley's ratio of irrigation water in the year 2013-14 were higher as compare to the year 2007-08 in Nashik region. From this results it is concluded that the irrigation water used for grape gardens in western Maharashtra showed higher values of EC, SAR and RSC in Sangli region in 2013-14 as compared to Solapur, Pune and Nashik regions that might be indication of maximum accumulation salts in soil, might be resulted into salt affected soil.

Key words: Grape, Irrigation water, Analysis of salty water.

Introduction

Water is essential to the existence of man and all living things (Deshpande and Aher, 2012). Decreasing trend of precipitation in recent years has deteriorated ground water quality in terms of increased soluble salts. Grape vines are sensitive to high levels of soluble salts and toxic ions in both soil and irrigation water (Bhargava *et al.*, 2006). It is often intentionally grown under a water deficit to meet wine quality goals (Shellie and Brown 2012). Commercial viticulture in India is hardly a few decades old and major grape growing states are Maharashtra, Karnataka, Tamil Nadu, Andhra Pradesh, Punjab and Haryana (Yogeeshappa *et al.*, 2013). The area under grape in country is 117.6 thousand ha with a total production 2,483.1 thousand ton and productivity of 21.1 t ha⁻¹ (Anonymous, 2013a). Among the grape growing states, Maharashtra occupies the largest area with 90

thousand ha under the crop with 2050 a thousand tone production and 22.8 t ha⁻¹ (Anonymous 2013b). Among the state Nashik and Sangli district are fore front with Pune, Satara, Solapur, Ahmednagar, Osmanabad, and Latur districts are also under cultivation.

Grape is an irrigated crop, although its cultivation is limited to rain shadow area of the country and ground water is the major source of irrigation. Above ground water is used through drip and it is the most widely used irrigation method for grape gardens and it facilitates manipulation of vine water status by providing temporal and spatial control of the wetted area within a vine row (Shellie and Brown 2012). Reduced soil moisture, resulting from deficit irrigation, decreases vine nutrient uptake by reducing the transpiration stream and by limiting diffusion of nutrients to root surfaces. Thus, quality of irrigation water is important consideration before

planting vines and later for its production and quality. The good quality water is an important consideration in the appraisal of salinity and alkalinity in irrigated areas. Therefore this study is planned to assess the quality of irrigation water used in viticulture.

Materials and Methods

Five hundred five irrigation water samples were collected and analyzed during 2007-08 and three hundred twelve irrigation water samples were collected and analyzed during 2013-14 from different grape growing regions of western Maharashtra such as Pune, Nashik, Sangli and Solapur. Irrigation water sources included mainly bore wells, open wells and canals. Analysis was done in the laboratory of Maharashtra State Grape Growers' Association (M.R.D.B.S.) and Division of Soil Science and Agricultural Chemistry, College of Agriculture, Pune. pH, and Electrical conductivity were determined by potentiometer and conductometric method. Chlorides were estimated by Mohr's titration with

standard AgNO₃ titration, Carbonates and bicarbonate were estimated by titrimetric method, calcium and magnesium were estimated with Versenate method, and content of potassium and sodium was estimated by flame photometrically, employing ELICO Flame Photometer. NO₃-N was estimated by phenol di-sulphonic acid method (Richard 1968).

Result and Discussion

From the five hundred samples analyzed during 2007-08 and three hundred twelve samples analyzed during 2013-14 the following results were revealed:

pH: In both the years, 2007-08 and 2013-14 Solapur region showed higher pH and whereas Sangli region showed lower pH. Out of 184 water samples analyzed during 2007-08 none of sample was found in safe category. In Sangli region 84.62% samples were found safe category having pH 6-7 during 2007-08.

Table 1: Quality of irrigation water during 2007-08 and 2013-14

2007-08				
	Pune	Nashik	Sangli	Solapur
pH	7.86	7.81	7.72	7.88
EC	1.57	1.30	1.60	1.26
Ca ²⁺	5.41	5.48	5.70	4.65
Mg ²⁺	2.88	3.17	2.38	2.21
Na ⁺	5.51	3.09	4.92	3.79
K ⁺	0.04	0.06	0.02	0.03
Cl ⁻	5.45	4.71	8.25	4.47
CO ₃ ²⁻	1.05	0.76	T	1.40
HCO ₃ ⁻	7.20	6.67	5.84	5.90
NO ₃ -N	10.84	14.76	8.77	8.94
SAR	2.81	1.48	2.63	2.20
RSC	-1.04	-1.91	-2.25	-0.91
Mg:Ca	0.74	0.61	0.46	0.55
KR	0.80	0.59	0.81	0.81

2013-14				
	Pune	Nashik	Sangli	Solapur
pH	7.58	7.54	7.52	7.64
EC	1.32	1.51	2.27	1.58
Ca ²⁺	4.72	5.32	7.84	6.40
Mg ²⁺	2.69	2.95	4.16	3.11
Na ⁺	5.13	5.52	9.05	0.43
K ⁺	0.18	0.04	0.03	0.04
Cl ⁻	4.01	6.29	9.83	6.26
CO ₃ ²⁻	T	T	1.22	T
HCO ₃ ⁻	6.97	7.08	7.76	6.22
NO ₃ -N	12.28	17.54	12.26	10.09
SAR	1.91	2.73	3.76	2.85
RSC	-0.44	-1.19	-46.4	-3.36
Mg:Ca	0.65	0.73	0.57	0.54
KR	0.72	1.09	0.83	0.86

In 2013-14 only 2.43% and 7.84% samples were in safe category in Solapur and Sangli regions respectively.

Electrical Conductivity (EC): Conductivity is the measure of capacity of a substance to conduct the electric current. The samples from Sangli region showed higher EC (dSm⁻¹) in both the years (1.60 dSm⁻¹) and (2.27 dSm⁻¹) in 2007-08 and 2013-14

respectively and but out of total samples 36% and 23.52% irrespective years were considered as in safe (<1 dSm⁻¹) category. Among the regions Solapur region showed lower EC (1.26 dSm⁻¹) with 40.45% water samples are in safe category during 2007-08. Whereas in 2013-14 lower EC was found in Pune region (1.32 dSm⁻¹) and 34.61 % samples in safe category.

Calcium: Calcium is a determinant of water hardness, because it can be found in water as Ca^{2+} ions. During 2007-08 Sangli region showed higher calcium content (5.70 meL^{-1}) in the irrigation water samples with 30.83% samples under safe category having Ca^{2+} content $<3.75 \text{ me L}^{-1}$ and Solapur region has the lowest calcium content (4.65 me L^{-1}) having 45.66% samples in safe category. In 2013-14 also Sangli region showed higher calcium in their waters (7.84 me L^{-1}) with 23.53% samples considered to be safe whereas Pune region showed lower calcium (4.72 me L^{-1}) in the irrigation water samples of this region showing 38.46% samples to be in safe category for irrigation.

Magnesium: A large number of minerals contain magnesium; Magnesium is washed from rocks and subsequently ends in water. The content of magnesium in the irrigation waters was changed in both the years. During 2007-08 Mg^{2+} content in water sample was high in Nashik region (3.17 me L^{-1}) and 29.34% samples were comes in s safe category having $\text{Mg}^{2+} <2.0 \text{ me L}^{-1}$ in their waters and lowest in Solapur region with 61.40% samples under safer category. In 2013-14 Sangli and Pune region showed higher and lower magnesium content in the water samples with 23.54% and 24.04% samples respectively in safe category. From this results it is seen that the situation in respect to both these cations (Ca and Mg) was not changed in both the years.

Sodium: The Na^+ content in irrigation water (5.51 me L^{-1}) was higher in Pune region with 18.87% samples were considered as safe ($<2.0 \text{ me L}^{-1}$) and lower in Nashik region (3.09 me L^{-1}) having 48.35% samples in safe category during 2007-08. During 2013-14 Sangli and Solapur region showed higher (9.05 me L^{-1}) and lower (0.43 me L^{-1}) content of sodium respectively. However, Sangli region showed 3.37% and Solapur region showed 21.95% samples were in safe category.

Potassium: The main sources of potassium in ground water include rain water, weathering of potash silicate minerals, use of potash fertilizers and use of surface water for irrigation. Though potassium

is extensively found in some of igneous and sedimentary rocks, its concentration in natural waters is quite low due to the fact that potassium minerals offer resistance to weathering and dissolution. The potassium content was found higher in Nashik region 2007-08 and in 2013-14 higher in Pune region and lower in Sangli region in both the years. All the samples in all the regions were considered to be safe as it was present in very small quantity.

Carbonates: Carbonates were found to be higher in Solapur region and 93.48 % samples were considered to be in safe category having no carbonates in the water samples during 2007-08 and Sangli region showed lower concentration during 2007-08 but highest in 2013-14 and in having 100% and 98.09% samples in safe category.

Bicarbonates: Alkalinity is the measure of the capacity of the water to neutralize a strong acid. Bicarbonates were found higher in Pune region and lower in Sangli region during 2007-08 but in 2013-14 Sangli region has got highest bicarbonates whereas Solapur region has got lowest bicarbonates content in their irrigation water samples. In Pune region 83.02% samples were samples were under safe category having HCO_3^- content $<10 \text{ me L}^{-1}$ and in Sangli region 100% samples were in safe category. During 2013-14 Sangli region showed 78.44% samples in safe category and in Solapur region 92.68% samples were in safe category.

Chloride: The chloride estimation revealed that during 2007-08 and 2013-14 Sangli region showed higher chloride content in their waters and Solapur region has got lower chloride during 2007-08 and Pune region showed lower chloride during 2013-14. In Sangli region 30.77% samples having chloride content $<3 \text{ me L}^{-1}$ were considered under safe category and in Solapur region 52.17% samples under safe category. During 2013-14 it was found that Sangli region had 17.65% samples under safe and Pune region had 49.04% samples in safe category.

Nitrate Nitrogen: Water rich in $\text{NO}_3\text{-N}$ is equally good for irrigating grapes and other crops to a certain extent but $\text{NO}_3\text{-N}$ ($>10 \text{ ppm}$) is not

considered safe for drinking water. In both the years Nashik region showed higher content of nitrate nitrogen in irrigation water samples and Sangli region showed lower concentration in 2007-08 and Solapur region in 2013-14.

Derived parameters: based on the cation and anion concentration present in irrigation water samples of different regions, derived parameters were calculated.

Sodium Adsorption Ratio (SAR): During 2007-08 SAR was found higher in Pune region and lower in Nashik region that to in 2013-14 it was higher in Sangli region and lower in Pune region. SAR value more than 10 was considered safe and during 2007-08 in Pune region 100% samples were considered safe and in Nashik region 98.76% samples were considered to be safe. In 2013-14 Sangli region showed 92.16% samples in safe category whereas 98.11% samples in safe category.

Residual Sodium Carbonate (RSC): Residual sodium carbonate was seen to be high in Sangli

region in both the years and lower in Solapur and Pune region in 2007-08 and 2013-14 respectively. Sangli region showed 73.07% samples in safe category having $RSC < 1.25 \text{ me L}^{-1}$ and in Solapur region having 68.48%. In 2013-14 Sangli region had 78.43% samples in safe and in Pune 69.23 % samples in safe category.

Mg:Ca ratio: This ratio was found higher in Pune and Nashik region and lower in Sangli and Solapur region during 2007-08 and 2013-14 respectively. Mg:Ca ratio < 1.5 was considered to be safe for irrigation. In 2007-08 in Pune region 94.33 %, Solapur region 97.29% samples Nashik region having 94.11% and in Solapur region 99.19% were considered to be safe for irrigating grape gardens.

Kelley's Ratio (KR): Kelley's ratio was found higher in Sangli and Solapur during 2007-08 and lower in Nashik. But during 2013-14 it was found high in Nashik and low in Pune.

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