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Effect of ground water quality on soil characteristics in Pentakali command area of Buldhana district of Maharashtra

Ajay S Solanki, Satishchandra M Jadhao, Tejashree A Shirolkar, Kiran S Ingale, Samadhan P Kale and Jaipal Yadav

Abstract
The present investigation entitled "Assessment of ground water quality in Pentakali command area of Buldhana district of Maharashtra" was undertaken during 2017-2019 in Department of Soil Science and Agricultural Chemistry, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola, Maharashtra. The objective of the investigation was to assess the effect of irrigation on soil properties in Pentakali command area of Buldhana district of Maharashtra the water samples from fourty open wells were collected in three different season viz. pre monsoon (summer), monsoon (rainy) and post monsoon (winter). The ground water samples from fourty open wells were collected from nine village's in Pentakalicommand area. This result showed that the impact of ground water on soil was noticeable in pre monsoon and monsoon season as compared to the post monsoon season, which is suitable for irrigation. Ground water should be analyzed in all three season for safe use.

Keywords: Pentakali command area, before irrigation, after irrigation, saturation paste, permissible limit, soluble sodium percentage

Introduction
The water is the major source for irrigation in our country. The water quality reflects inputs from the atmosphere, soil, water-rock weathering and pollutant sources. It required for irrigation depends up on the dissolved salts like Na, Ca, Mg and HCO_3 in water (CGWB, 2019) [1]. several approaches were used to assess the hydro–geochemical properties of groundwater and to determine its suitability for drinking and agriculture. Rashid *et al*., 2021 [2] Anthropogenic activities and natural environmental variations are the two major driving forces of regional hydrology and changes to water body resources (Anapalli *et al*., 2019) [3]. Global rate of hiking population and the rapid rate of industrialization as in the name of globalization have led to create excessive demand for valuable resources in available nature, which has subsequently resulted in several social and ecological constraints. These burning issues inevitably exacerbate the mankind impact on the climate change, particularly on resources of surface water and groundwater bodies (Feng *et al*., 2020) [4]. However, such water influences crops yield. Ground water is a vital component of agriculture support system and its quality directly affects soils and crops and their management. High quality crop is possible only by using high-quality ground water. Characteristics of water can vary with its source. Regional differences in water characteristics will result from variation in geology and climate. The salts present in poor quality water affect the crop growth, yield and quality of produce by increasing the osmotic potential thereby reducing water availability and nutrient uptake. Deterioration in the quality of water used for irrigation is a matter of concern in recent years. Water is usually classified as hard water or soft water according to concentration of calcium and magnesium ions. Generally hard water makes land soft and soft water makes land hard. The chemical constituents of irrigation water can affect plant growth directly through toxicity or deficiency or indirectly by altering availability of nutrients (Ayers and Westcot, 1985; Rowe and Magid, 1995) [5, 6]. The chemical characteristics interact with each other and cause hazardous effect on soil properties and crop growth. Such as the EC, SAR, RSC are considered together in classifying the water.
The irrigated area in command area under the jurisdiction of Water Resources Department, GoM is 39.50 lakh ha in 2017-18 (Anonymous, 2019) [7]. In India 51 per cent of irrigation is by well out of the total irrigation potential where as in Maharashtra irrigation by well is about

56 percent and by canal is about 23 percent (Anonymous, 2010) [8]. Ground Water Quality CGWB is monitoring the ground water quality of the Buldhana district for the last four decades through its monitoring wells. However dugwells are the main ground water abstraction structures in the district. The yield of dugwells in Alluvium and in Basalt varies from 5 to 100 m^3 day^{-1}. High yielding dugwells are generally located in weathered and fractured Vesicular Basalt occurring in physiographic depressions. The yield of borewells varies from 100 – 43850 lph, whereas that of tubewells varies from 100 – 64530 lph. (Anonymous, 2013) [9]

Materials and Methods

The present laboratory investigation entitled "Assessment of Ground Water Quality in Pentakali Command Area of Buldhana District of Maharashtra" was taken with two objectives viz. to assess the quality ground of the ground water of Pentakali command area and to study the soil characteristics of command area. The ground water samples from fourty open wells were collected from nine village's viz. Pentakali, Pimpalgaon Unda, Naigaon Kh, Naigaon Bk, Sawangi Gawali, Mangrul Navghare, Savarkhed Bk, Dhumalwadi, Dongargaon in Pentakalicommand area. Irrigation water analysis was carried out at soil and water testing laboratory Department of Soil Science and Agricultural Chemistry, Dr. PDKV., Akola during 2017-2019. Ground water quality and soil data were collected form open and dung wells. All samples were labeled properly, and according to the prerequisites for the water quality parameters like EC, pH, TDS, Ca and Mg were analyzed in the Pentakali dam command area. The sample was collected fourth different locations of Buldhana region during pre monsoon, monsoon season and post monsoon season and soilsample during beforeand after irrigation were analyzed various parameters of water viz.,pH_s, EC_e, Calcium (Ca^{2+}), Magnesium (Mg^{2+}), Sodium (Na^+), Potassium (K^+), Carbonate (CO_3^{2-}), Bicarbonate (HCO^{3-}), Chloride (Cl^-), Sulphate (SO_4^{2}). The sample were analyzed by the standard method protocols. Buldhana is the western most district of Vidarbha. It lies between 19°51' to 21°17' north latitudes and 75°57' to 76°59' east longitudes and falls in survey of India Toposheets 55-A, 55-C, 55-D and 55-P. The district covers a total geographical area of 9670.00 sq.km.

Results and Discussion

Soil characteristics of command area

Effect of ground water on pH_s and $EC_e$of soil

The saturation paste extract analysis of soil indicated that the pH_s was in the range of 7.10 to 7.81 and 7.15 to 7.95 (Table 1) before and after irrigation due to high proportion of bicarbonate ions which dissociates more hydroxyl ions on dilution. Similar reasearch trend were also reported by Dubey *et al.* (1983) [10].

Electrical Conductivity (ECe) (dSm^{-1})

The electrical conductivity of saturation paste extract (EC_e) was in the range of 0.48 to 0.87 before irrigation and 0.60 to 0.98 dSm^{-1} after the irrigation (Table 1). The highest values of ECe may be due to the continuous use of salt affected water for irrigation. Similar results were also obtained by Bharambe*et et al.* (2001) [11] in Jayakwadi command area.

Cations

The data regarding cationic concentration in saturation paste extract is mentioned in Table 2, which reveals that the concentration of calcium content was 1.7 to 2.9 meL^{-1} and 1.9 to 3.2 meL^{-1} during before and after irrigation. The magnesium concentration was in the range of 1.4 to 2.7 meL^{-1} before irrigation however it was 1.6 to 2.9 after the irrigation, in case of sodium content it ranges between 2.02 to 3.56 meL^{-1} before application of irrigation and this expands from 2.16 to 3.73 after irrigation where as the potassium content was in the range of 0.34 to 0.69 meL^{-1} and 0.47 to 0.89 during before and after irrigation. The dominance of Na^+ over Ca^{2+}, Mg^{2+} and K^+ ions in the saturation extract of the salt affected soils was also reported by Kotur and Seshagiri (1987) [12] and More *et al.* (1988) [13]. Several authors have also reported the incidence of concentration of Nain the command areas (Jain *et al.* 2000) [14].

Table 1: Effect of ground water irrigation on soil pH_s and EC_e(dSm^{-1})

Particulars	pH_s		EC_e	
	Before irrigation (Summer)	After irrigation (Winter)	Before irrigation (Summer)	After irrigation (Winter)
S_1	7.46	7.58	0.54	0.62
S_2	7.66	7.74	0.61	0.75
S_3	7.34	7.49	0.54	0.63
S_4	7.41	7.52	0.70	0.82
S_5	7.58	7.74	0.87	0.98
S_6	7.22	7.34	0.72	0.86
S_7	7.51	7.64	0.69	0.83
S_8	7.63	7.75	0.78	0.89
S_9	7.17	7.30	0.84	0.96
S_{10}	7.49	7.65	0.72	0.87
S_{11}	7.11	7.20	0.80	0.94
S_{12}	7.12	7.15	0.84	0.93
S_{13}	7.67	7.79	0.71	0.84
S_{14}	7.63	7.75	0.87	0.96
S_{15}	7.65	7.77	0.73	0.86
S_{16}	7.22	7.34	0.80	0.92
S_{17}	7.44	7.58	0.58	0.80
S_{18}	7.49	7.60	0.84	0.89
S_{19}	7.78	7.90	0.48	0.60
S_{20}	7.19	7.31	0.86	0.95
S_{21}	7.36	7.44	0.78	0.96

S_{22}	7.34	7.48	0.78	0.92
S_{23}	7.51	7.63	0.75	0.83
S_{24}	7.61	7.75	0.68	0.76
S_{25}	7.72	7.80	0.75	0.92
S_{26}	7.24	7.36	0.72	0.85
S_{27}	7.78	7.92	0.68	0.82
S_{28}	7.81	7.95	0.55	0.70
S_{29}	7.70	7.83	0.78	0.88
S_{30}	7.56	7.68	0.62	0.72
S_{31}	7.64	7.72	0.71	0.82
S_{32}	7.75	7.84	0.68	0.87
S_{33}	7.52	7.67	0.81	0.90
S_{34}	7.64	7.78	0.82	0.96
S_{35}	7.74	7.88	0.56	0.72
S_{36}	7.60	7.76	0.67	0.89
S_{37}	7.32	7.45	0.71	0.88
S_{38}	7.51	7.62	0.65	0.86
S_{39}	7.10	7.22	0.67	0.78
S_{40}	7.58	7.72	0.62	0.74
Mean	7.49	7.61	0.71	0.84
Range	7.10 - 7.81	7.15 - 7.95	0.48 - 0.87	0.60 - 0.98

Table 2: Effect of ground water irrigation on Cationic concentration of soil

Particular	Soluble cations (meL^{-1})							
	Ca^{2+}		Mg^{2+}		Na^{+}		K^{+}	
	BI	AI	BI	AI	BI	AI	BI	AI
S_1	1.7	1.9	1.4	1.6	2.34	2.76	0.60	0.75
S_2	2.1	2.4	1.8	2.3	2.24	2.65	0.67	0.89
S_3	1.7	1.9	1.4	1.7	2.45	2.76	0.60	0.72
S_4	2.3	2.5	2.2	2.3	2.42	2.82	0.59	0.85
S_5	2.9	3.2	2.5	2.7	3.38	3.72	0.45	0.52
S_6	2.5	2.8	2.3	2.5	2.28	2.96	0.58	0.75
S_7	2.6	2.8	2.3	2.6	2.52	2.64	0.36	0.69
S_8	2.7	2.9	2.4	2.6	2.76	3.06	0.59	0.80
S_9	2.8	3.0	2.6	2.9	3.15	3.55	0.47	0.56
S_{10}	2.6	2.8	2.3	2.5	2.85	3.22	0.47	0.62
S_{11}	2.8	3.1	2.5	2.7	2.86	3.46	0.38	0.82
S_{12}	2.7	2.9	2.6	2.8	2.96	3.27	0.55	0.86
S_{13}	2.5	2.8	2.3	2.5	2.82	3.16	0.36	0.68
S_{14}	2.9	3.0	2.5	2.6	3.17	3.34	0.49	0.74
S_{15}	2.7	2.9	2.4	2.7	2.78	3.28	0.60	0.65
S_{16}	2.6	2.9	2.5	2.8	2.86	3.34	0.64	0.75
S_{17}	2.5	2.8	2.3	2.6	2.45	2.86	0.37	0.56
S_{18}	2.7	2.9	2.4	2.7	3.09	3.35	0.59	0.68
S_{19}	2.3	2.5	2.1	2.3	2.02	2.16	0.40	0.47
S_{20}	2.9	3.0	2.7	2.9	2.92	3.35	0.48	0.6
S_{21}	2.7	3.0	2.6	2.9	3.14	3.48	0.59	0.64
S_{22}	2.6	2.9	2.4	2.6	3.56	3.73	0.50	0.59
S_{23}	2.5	2.7	2.3	2.5	2.68	2.84	0.56	0.67
S_{24}	2.4	2.5	2.3	2.4	2.32	2.64	0.50	0.60
S_{25}	2.7	2.9	2.4	2.6	3.35	3.58	0.37	0.53
S_{26}	2.5	2.8	2.4	2.6	2.59	2.91	0.40	0.49
S_{27}	2.5	2.7	2.3	2.5	2.85	3.26	0.48	0.56
S_{28}	2.3	2.4	2.2	2.3	2.55	2.92	0.38	0.57
S_{29}	2.6	2.8	2.4	2.6	2.78	3.15	0.60	0.70
S_{30}	2.3	2.5	2.1	2.3	2.47	2.64	0.39	0.48
S_{31}	2.5	2.7	2.2	2.4	2.72	2.96	0.45	0.55
S_{32}	2.7	2.9	2.3	2.6	2.86	3.22	0.43	0.57
S_{33}	2.7	3.0	2.5	2.8	2.91	3.14	0.34	0.50
S_{34}	2.6	3.0	2.5	2.9	2.86	3.25	0.69	0.89
S_{35}	2.4	2.5	2.1	2.3	2.57	2.86	0.40	0.50
S_{36}	2.7	2.9	2.4	2.6	3.18	3.35	0.46	0.66
S_{37}	2.6	2.9	2.4	2.7	3.35	3.46	0.45	0.60
S_{38}	2.6	2.8	2.3	2.7	2.62	2.86	0.60	0.67
S_{39}	2.4	2.6	2.2	2.3	2.71	2.96	0.36	0.48
S_{40}	2.6	2.7	2.2	2.4	2.24	2.65	0.39	0.50
Mean	2.5	2.7	2.3	2.5	2.76	3.08	0.48	0.64

Range	1.7-2.9	1.9-3.2	1.4-2.7	1.6-2.9	2.02-3.56	2.16-3.73	0.34-0.69	0.47-0.89

BI = Before irrigation, AI = After irrigation

Table 3: Effect of ground water irrigation on Anionic concentration of soil

Particulars	Soluble anions (meL^{-1})					
	HCO_3^-		Cl^-		SO_4^{-2}	
	BI	AI	BI	AI	BI	AI
S_1	2.5	2.7	1.6	2.4	2.24	2.55
S_2	3.0	3.3	1.9	1.6	2.82	3.12
S_3	2.7	2.9	1.7	1.4	2.56	2.86
S_4	3.2	3.4	2.1	1.8	3.02	3.34
S_5	3.8	3.9	2.7	2.6	2.52	3.65
S_6	3.1	3.4	2.5	2.3	3.12	3.24
S_7	3.3	3.5	1.9	1.7	2.25	3.35
S_8	3.3	3.6	2.6	2.2	3.24	3.46
S_9	3.6	3.8	2.5	2.3	3.48	3.62
S_{10}	3.4	3.6	2.7	2.5	3.24	3.52
S_{11}	3.5	3.7	2.7	2.4	3.32	3.45
S_{12}	3.5	3.8	2.6	2.4	3.27	3.68
S_{13}	3.2	3.4	2.3	2.0	2.92	3.22
S_{14}	3.5	3.8	2.7	2.4	3.65	3.73
S_{15}	3.2	3.5	2.4	2.2	3.06	3.24
S_{16}	3.5	3.7	2.5	2.2	3.42	3.67
S_{17}	3.0	3.4	2.6	2.2	2.74	3.14
S_{18}	3.3	3.5	2.7	2.5	2.85	3.25
S_{19}	2.7	3.1	1.9	1.5	2.46	2.94
S_{20}	3.4	3.7	2.9	2.4	3.17	3.55
S_{21}	3.3	3.7	2.9	2.5	3.03	3.32
S_{22}	3.3	3.5	2.7	2.4	2.86	3.18
S_{23}	3.0	3.3	2.5	2.3	2.76	3.12
S_{24}	2.7	3.1	2.3	2.0	2.65	2.85
S_{25}	3.3	3.6	2.8	2.5	3.17	3.42
S_{26}	3.1	3.3	2.6	2.2	2.82	3.09
S_{27}	2.8	3.2	2.7	2.4	2.75	2.92
S_{28}	2.5	2.8	2.1	2.0	2.32	2.64
S_{29}	3.1	3.4	2.5	2.3	3.04	3.25
S_{30}	2.5	2.8	2.2	2.0	2.25	2.64
S_{31}	3.2	3.4	2.6	2.4	2.96	3.22
S_{32}	2.9	3.3	2.7	2.4	2.76	3.14
S_{33}	3.2	3.5	2.8	2.4	2.86	3.36
S_{34}	3.5	3.8	2.7	2.5	3.35	3.42
S_{35}	2.9	3.1	2.1	1.7	2.52	2.85
S_{36}	3.0	3.3	2.7	2.5	2.75	3.24
S_{37}	3.2	3.6	2.7	2.3	3.16	3.48
S_{38}	3.1	3.4	2.6	2.3	2.78	3.03
S_{39}	2.8	3.1	2.4	2.2	2.65	2.92
S_{40}	2.7	2.9	2.3	2.0	2.45	2.72
Mean	3.1	3.3	2.4	2.2	2.8	3.2
Range	2.5-3.8	2.7-3.9	1.6-2.9	1.4-2.6	2.24-3.65	2.55-3.73

BI = Before irrigation, AI = After irrigation

Anions

The data presented in Table 3, reveals that among the anions bicarbonate content was in the range of 2.5 to 3.8 meL^{-1} and 2.7 to 3.9 before and after the irrigation. Chloride concentration of soil was in the range of 1.4 to 2.6 meL^{-1} and 1.6 to 2.9 before and after irrigation which might be due to the increasing electrical conductivity of ground water. Sulphate concentration of soil was in the range of 2.24 to 3.65 and 2.55 to 3.73 before and after the irrigation. Kharde (1992) [15] indicated similar results that the anionic concentration that the bicarbonate ions in saturation paste extract dominated over other anions and showed the average abundance of anions in the order of HCO_3^-> SO_4^{2-}> Cl^-.

Nutrient potential of soil

Nitrogen concentration of soil was in the range of 100.32 to 175.2 and 105.2 to 178.98 before and after the irrigation. The available nitrogen content was low in major portion of the study area because of low organic matter content in these soils. The variation in N content may be related to soil management, application of organic manures and fertilizers to previous crops. The similar observations were recorded by Dhage *et al.* (2000) [16]. Phosphorus concentration of soil was in the range of 14.47 to 27.1 and 19.15 to 29.87 during before and after irrigation. Low status of available P in soils of studied area might be due to alkaline soil reaction and high content of $CaCO_3$ in the soil. At the higher pH calcium can precipitate with P as Ca phosphate and reduce phosphorus availability. Similar results were also reported by Kumar *et al.* (2015) [17].

Table 4: Effect of ground water irrigation on nutrient potential of soil (kg ha^{-1})

Particulars	N		P	
	BI	AI	BI	AI
S_1	175.20	178.24	24.75	28.50
S_2	150.52	154.27	21.24	23.24
S_3	125.44	129.34	19.60	22.50
S_4	163.72	165.34	16.23	21.33
S_5	150.52	153.58	16.90	20.10
S_6	137.98	142.31	17.20	24.50
S_7	125.44	129.34	18.76	23.46
S_8	137.98	145.98	16.33	20.12
S_9	125.44	128.19	22.23	26.28
S_{10}	137.44	139.17	21.33	24.86
S_{11}	125.84	128.34	15.18	21.18
S_{12}	163.72	166.19	24.68	28.41
S_{13}	150.28	155.60	24.41	25.61
S_{14}	100.32	105.20	20.30	24.18
S_{15}	163.72	168.27	22.18	27.10
S_{16}	112.89	115.23	21.23	26.87
S_{17}	150.51	154.27	19.24	23.21
S_{18}	163.87	166.98	19.11	25.13
S_{19}	112.89	115.80	17.35	23.18
S_{20}	150.51	154.23	18.36	22.21
S_{21}	112.19	116.28	17.15	24.12
S_{22}	125.67	129.57	20.40	24.27
S_{23}	163.18	165.28	14.47	19.15
S_{24}	150.21	154.17	23.50	26.60
S_{25}	125.37	128.64	25.20	28.21
S_{26}	163.19	165.80	25.23	28.12
S_{27}	175.10	178.98	26.08	27.06
S_{28}	173.21	178.70	23.74	27.05
S_{29}	137.80	140.20	27.10	29.87
S_{30}	112.18	115.18	23.54	25.17
S_{31}	137.19	142.50	21.64	26.37
S_{32}	150.21	155.60	21.23	24.68
S_{33}	135.19	138.21	19.69	23.19
S_{34}	152.18	155.12	18.46	22.27
S_{35}	131.24	135.54	17.18	24.67
S_{36}	137.50	141.40	21.65	25.19
S_{37}	125.80	129.53	22.10	27.18
S_{38}	125.85	128.41	18.51	22.67
S_{39}	112.86	116.58	20.40	24.80
S_{40}	150.28	154.20	18.81	25.27
Mean	137.03	140.85	21.08	25.26
Range	100.32 - 175.2	105.2 - 178.98	14.47 - 27.1	19.15 - 29.87

BI = Before irrigation, AI = After irrigation

Micronutrient Potential in soil

Table 5: Effect of ground water irrigation on micronutrient Potential in soil

Particulars	Micronutrient content in soil (mg kg^{-1})							
	Fe		Mn		Zn		Cu	
	BI	AI	BI	AI	BI	AI	BI	AI
S_1	4.60	4.80	3.26	3.51	0.25	0.34	2.20	2.42
S_2	5.34	5.85	2.36	2.50	0.76	0.84	1.89	2.10
S_3	3.89	4.00	3.21	3.37	0.63	0.62	2.99	2.18
S_4	3.94	4.18	4.16	4.30	0.32	0.44	1.35	1.55
S_5	5.65	6.10	4.36	4.55	0.49	0.58	2.06	2.36
S_6	3.43	3.87	1.84	2.12	0.36	0.48	1.23	1.34
S_7	3.46	3.80	4.24	4.80	0.32	0.41	1.24	1.45
S_8	2.97	3.20	2.98	3.10	0.21	0.35	2.92	3.12
S_9	5.18	5.40	3.12	3.80	0.24	0.38	1.38	1.53
S_{10}	2.56	2.87	4.32	4.70	0.53	0.62	1.87	1.98
S_{11}	3.28	3.58	3.62	4.10	0.63	0.74	1.92	2.10
S_{12}	5.96	6.20	2.99	3.30	0.61	0.71	1.32	1.41
S_{13}	3.87	4.12	4.47	4.97	0.55	0.63	1.63	1.82
S_{14}	4.45	4.97	3.25	3.53	0.43	0.55	1.28	1.50

S_{15}	2.29	2.85	3.98	4.30	0.24	0.36	1.82	2.10
S_{16}	3.19	3.39	3.89	4.12	0.54	0.64	2.76	2.98
S_{17}	5.62	5.92	4.20	4.53	0.74	0.86	2.16	2.24
S_{18}	4.29	4.65	2.24	2.34	0.63	0.78	2.45	2.75
S_{19}	3.28	3.57	3.36	3.51	0.73	0.87	2.36	2.48
S_{20}	5.42	5.79	3..68	3.70	0.79	0.92	1.75	2.01
S_{21}	2.78	3.10	4.36	4.80	0.34	0.47	3.12	3.30
S_{22}	2.12	2.40	2.34	2.87	0.38	0.49	2.53	2.80
S_{23}	2.18	2.28	3.84	4.10	0.88	0.98	2.45	2.63
S_{24}	3.23	3.58	3.18	3.50	0.23	0.34	3.11	3.42
S_{25}	5.89	5.98	2.21	2.60	0.49	0.57	2.23	2.53
S_{26}	4.42	4.8	3.23	3.58	0.36	0.49	1.36	1.65
S_{27}	3.69	3.92	4.21	4.78	0.53	0.65	1.98	2.25
S_{28}	4.39	4.75	2.98	3.31	0.88	0.95	1.73	1.85
S_{29}	2.74	2.95	2.94	3.20	0.32	0.45	1.87	1.98
S_{30}	3.96	4.13	3.84	4.12	0.34	0.42	1.56	1.87
S_{31}	5.39	5.65	2.61	3.08	0.24	0.32	1.63	1.95
S_{32}	3.67	3.85	2.45	2.85	0.65	0.73	1.35	1.55
S_{33}	2.94	3.25	4.12	4.60	0.63	0.75	1.72	1.93
S_{34}	4.47	4.65	3.13	3.42	0.24	0.35	2.33	2.63
S_{35}	4.75	4.98	3.27	3.65	0.49	0.63	3.13	3.47
S_{36}	3.78	3.95	1.56	1.87	0.38	0.51	2.16	2.40
S_{37}	2.53	2.87	1.82	2.25	0.67	0.79	2.45	2.62
S_{38}	4.36	4.68	2.16	2.69	0.21	0.31	3.10	3.42
S_{39}	5.29	5.60	4.12	4.85	0.61	0.75	2.68	2.85
S_{40}	2.94	3.25	3.36	3.70	0.24	0.36	2.23	2.58
Mean	3.95	4.24	3.27	3.62	0.47	0.58	2.08	2.28
Range	2.12 - 5.96	2.28 -6.20	1.56- 4.47	1.87 – 4.97	0.21 -0.88	0.31 -0.98	1.23 – 3.13	1.34 – 3.47

BI= Before irrigation AI= After irrigation

Iron concentration of soil was in the range of 2.12 to 5.96 and 2.28 to 6.20 before and after the irrigation respectively. Islam and Shamsad (2009) [18] studied the Iron (Fe) content of irrigation water samples of the command area which was varied from 0.00 to 0.112 meL^{-1} with an average value of 0.013 meL^{-1}.

Manganese concentration of soil was in the range of 1.56 to 4.47 and 1.87 to 4.97 before and after the irrigation respectively.

Zinc concentration of soil was in the range of 0.21 to 0.88 and 0.31 to 0.98 before and after the irrigation respectively.

Copper concentration of soil was in the range of 1.23 to 3.13 and 1.34 to 3.47 before and after the irrigation respectively. Srinivasarao *et al.* (2012) [19] also reported the 120 g ha^{-1} contribution of copper through irrigation water in ICRISAT watershed Pantcheru, Hyderabad.

Conclusion

As impact of ground water on soil, pH_s varied from 7.10 to 7.81 and 7.15 to 7.95 during before and after irrigation respectively. Whereas EC_e 0.48 to 0.87 dSm^{-1} and 0.60 to 0.98 dSm^{-1} during before and after irrigation respectively. While among the cations the concentration of sodium is dominated among all the cations in between 2.02 to 3.56 meL^{-1} and 2.16 to 3.73 during before and after irrigation season respectively, where as Ca^{2+} and Mg^{2+} dominant after sodium during before and after irrigation season. The concentration of K^+ very less during two season and among the anion HCO^-_3, Cl^-, SO_4^{2-} was dominant during after irrigation as compared to before irrigation. In the context of serious soil health decline, imbalanced use of fertilizers, multinutrient deficiency in soils, higher costs of chemical fertilizers, scarcity of organics etc. which necessitate exploration of possibility of utilizing various nutrient sources and ensuring balanced nutrient supply to the crops, the nutrient addition through irrigation needs to be taken into account. The quality of irrigation water also affects the physical properties of soil up to certain extent which needs to be study.

Application of Research

To know effect of ground water quality on soil characteristics.
To know effect of ground water on nutrient potential of soil.

Research Category

Ground Water Quality, Soil Characteristics

Abbreviations

ICRISAT, BI, AI, EC, TDS, SAR, RSC

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Author Contributions

All authors equally contributed

Author statement

All authors read, reviewed, agreed and approved the final manuscript.

Study Area/Sample Collection

Pentakali Command area of Buldhana district of Maharashtra
Cultivar/Variety/Breed name: Nil

Conflict of Interest

None declared

Ethical approval
This article does not contain any studies with human participants or animals performed by any of the authors.

Ethical Committee Approval Number
Nil

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