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Assessment of Physico-Chemical Properties of Soil in *Pomegranate orchards* from Sangamner and Rahata, Ahmednagar District (Maharashtra) India

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ABSTRACT: Soil is an essential natural source. In the present study, an analysis of the Physico-chemical parameters of soil in ten different villages of pomegranate orchards from the Sangamner and Rahata taluka was done. The soil samples were collected and analyzed to measure various physical and chemical parameters like pH, temperature, E.C, N, P, K, Carbon, Boron, and Sulfur. This research provides information regarding the soil's nature and the nutrients found in the soil of pomegranate orchards from study area. Sangamner and Rahata are geographically different so the selection of sampling sites for the analysis of soil parameters is difficult to compare the results. To overcome this problem found out the sampling sites of soil based on colour and texture. All soil parameters, including pH, temperature, E.C, N, P, K, Carbon, Boron and Sulfur are within normal limits.

Keywords: Physicochemical, properties, soil, pomegranate orchards, Sangamner, Rahata.

INTRODUCTION

India is one of the highest pomegranate production country in the world. India holds the first position in terms of areas under cultivation and total production of pomegranates. Pomegranates are widely produced in India's Maharashtra, Karnataka, Andhra Pradesh, Gujarat, and Rajasthan states. Himachal Pradesh and Madhya Pradesh are also seeing rapid growth. According to the National Horticultural Board (NHB) latest forecast for 2019-2020, the total land of pomegranate planted in India is 28,300 hectares with a record fruit production of 31.46 million tons. Of this, India exported 67.89 thousand tons of her, bringing in 6.885 billion rupees in foreign currency (Marathe *et al*., 2022).

The region has an arid to a semi-arid environment that is hot, and dry favorable to the cultivation of pomegranate (Marathe *et al*., 2016). According to the survey of Marathe *et al.* (2006) undertaken in pomegranate growing areas of Maharashtra revealed that it has been cultivated unintentionally on least capable soils, barren lands and even on the hilly terrains. Pomegranate can be grown on a wide range of soils from sandy soil to sandy loam soil (Kumar *et al*., 2018). The six elements of the soil, inorganic matter, organic matter, soil organisms, soil moisture, soil solution, and soil air combine to form a complex system. Approximately, the soil contains 50-60% mineral matter, 25-35% water, 15-25% air and little percentage of organic matter (Chatwal and Sharma 2005). The soil, climate, and water are all natural resources that significantly affect the different crops and crop yields in a particular region.

Ahmednagar is one of the leading districts for pomegranate cultivation in Maharashtra. Ahmednagar district lies in the shortage zone's arid region. Soil of the Ahmednagar' district is suitable for pomegranate cultivation. Now days in Ahmednagar district, Sangamner and Rahata taluka's are leading to the cultivation of pomegranate. Pomegranate cultivation is increasing as farmers can cultivate pomegranate in unirrigated land, also water requirement is less for pomegranate cultivation (Aher and Rahane 2016).

The economy of Sangamner and Rahata taluka's are mainly based on agriculture and agro-based industries. The regions are mainly dry and warm from the climate. The uses of organic and inorganic fertilizers have a positive impact not only on crop growth and yield but also on soil health (Dandwate, 2018). In recent years, agricultural development has shifted from traditional and traditional practices and through irrigation facilities to chemical fertilizers and pesticides using more intensive methods. The frequent use of chemical fertilizers will gradually change soil properties, eventually leading to a longer production decline. A variety of soil factors contribute to crop development. This survey aimed at assessing the quality of soil and physicochemical parameters status of the pomegranate cultivated soil in Sangamner and Rahatataluka.

MATERIAL AND METHODS

The Sangamner and Rahata are located in the northern part of the Ahmednagar district of Maharashtra. The area is drained by the Pravara River, which originates in the hilly region of Western Ghats at Ratangarh. Soil samples were collected from ten villages in Sangamner and Rahata taluka of Ahmednagar district in the Maharashtra.

Study Area and Selection of sampling sites:

Study area. The assessment of the physicochemical properties of soil was carried out from September 2019 to February 2020 from different localities of Sangamner and Rahata taluka, District Ahmednagar (MS) India. Soil samples were collected from ten different villages which cover the maximum study area. The study area lies between 19°34′37.7004′N and 74° 29′0.01324′E the climate of the region is influenced by the topography. Rainfall is moderate in the study area. Study area is a part of the northern part of the Ahmednagar district.

The location and sampling sites for analysis of Soil.

Sr. No.	Village name	Sampling site	GPS locations	
1.	Ashvi	V1	19° 30.7652' N	74° 17.5243′E
2.	Ambhore	V2	19.4817° N,	74.2799° E
3.	Sukhevadi	V3	19.5930° N,	74.2267° E
4.	Nilvande	V4	19.5391° N,	73.9051° E
5.	Nimgaonjali	V5	19.0952 N	74.7496E
6.	Loni	V6	19.712702	74.483337
7.	Pimprinirmal	V7	19.6399° N,	74.4886° E
8.	Astagaon	V8	19.6712° N,	74.5028° E
9.	Rajuri	V9	19.1499° N,	74.1398° E
10.	Kolhar	V10	19.2045° N,	74.8887° E

Soil analysis. The soil samples were collected and analysed to measure various physical and chemical parameters by standard methods from study area, during the period of September 2019 to February 2020. For analysis of soil samples and their properties, standard instrumental and non-instrumental techniques were used. It includes pH, temperature, E.C, N, P, K, Carbon, Boron and Sulfur using by standard protocols (Dalwadi and Bhatt 2008; Gupta, 2000; Verma, 2000, Thete, 2019; Deshmukh, 2012).

RESULTS AND DISCUSSION

A. Colour and Texture

In all sampling sites, the collected soil samples are light (pale or bleached) in colour and the texture of all soil samples is sandy loam, with the exception of soil sample of Nimgaonjali, which is silt loam in texture. The colour of the soil is a general indicator of its properties. Texture, on the surface, signifies soil fertility.

1. pH: The pH of soil may be used to identify whether it is naturally acidic or alkaline. In the current study, the minimum pH value was 6.34 reported at sampling site V3 in September, whereas the maximum pH value was 9.57 reported at sampling site V1 in month of September. The limit of pHvalue for soil Acidic < 6.5, Normal 6.5-7.8, Alkaline 7.8- 8.5, Alkali > 8.5. It indicates the soil is neutral. Light soil with pH range 6.5 to 7.0 is highly suitable for its cultivation; however it can tolerate pH up to8.5 under proper management practices (Kumar *et al.*, 2018.). The most significant physical property of soil is its PH, which increases plant nutrient accessibility. It exerts on the soil's solute concentration and absorption (Daji, 1996).

2. EC: Electric conductivity (EC) is a particularly quick, easy, and low-cost method for determining soil health. It is a measure of the ions in the solution. When the concentration of ions in the soil increases, the EC increases (Chik, 2011). Total soluble salts are estimated from electrical conductivity (EC) of aqueous soil extracts. As per standard methods values of EC in soil normal < 0.8 dsm^{-1}, critical for salt sensitive crops, critical for salt tolerant crops 1.6 -2.5 dsm^{-1}, Injurious to most crops > 2.5 dsm^{-1}.

In the present study minimum value of EC is 0.117dsm recorded at sampling site V2 in month of October and maximum value of EC is 0.676dsm reported at sampling site V5 in month of November. Previous investigation Marathe *et al.* (2015), reported in Maharashtra pomegranate orchids EC ranges between 0.007 – 1.74 dS/m. Soil EC is completely based on the amount of moisture content in soil particles. EC of the studied soil range from 0.117dsm to 0.676dsm similar results were observed by Marathe *et al.* (2015).

3. Organic Carbon: Carbon is an indicator of a soil's nitrogen content. In present investigation organic carbon values are ranges from 0.15% to 0.78 % recorded at sampling site V3 in month of February and V5 in month of January respectively. Crop residue, animal waste, cover crops, green manure, and organic fertiliser were always sources of organic carbon in the fertile soils (Gupta and Varsshaney 1994; Thete, 2019). The availability of organic carbon influences the kind and function of soil microorganisms. The values of organic carbon range from 0.15% to 0.78 %, similar results were reported by Ganorkar *et al.* (2017); Thete (2019).

4. Nitrogen: Nitrogen is a mobile nutrient in the soil and it is a fertilizer required for the growth of plants. Due to the importance of nitrogen for the development of plants, we tried to estimate available nitrogen from the soils in the study area. The available nitrogen was found between 140.67 kg/hector and 449.63kg/hector. In the present investigation minimum, N was reported at site V3 in the month of January and the highest value of N is reported at site V3 in the month of November. Patil *et al.* (2018), reported N values ranging between 98.56 to 250.64 kg ha^{-1} with an average of 155.67 kg ha^{-1} in pomegranate orchards from Jalna district (MS) India. The sewage water significantly increased the nitrogen in the soil (Baddesha *et al.*, 1997).

5. Phosphorus: The available phosphates were categorized as low, medium, and high. Inorganic phosphorus, in the form of orthophosphate, is vital in aquatic life. In the present investigation, the minimum value of P has been 3.26% at sampling site V1 in October and the maximum value of P 20.85% at sampling site V6 in December. P-containing complexes in alkaline soils differ greatly from those in neutral or acidic soils. The P values of the present investigation are similar to the results of Marathe *et al.* (2015), who reported the P value of orchard soil in Maharashtra ranging from 0.82 to 184.7%. The quantity of P

extracted during soil extraction is heavily influenced by the type of the P complexes (Olsen *et al.,* 1954). P value range from 3.26% to 20.85% Dandawate (2018); Thete (2019); from Sangamner & Patil *et al.* (2018) from Jalna District Maharashtra.

6. Potassium: Potassium (K) is present in the soil as bound potassium between soil layers. The lowest K value were 388.4% at sampling site V6 in February, while the highest potassium value was 1490% at sampling site V1 in September. Potassium is not an essential component of any major plant component, but it is essential for plant development, protein synthesis, and the maintenance of plant water balance (Sumithra, 2013). The present values are matches with the results of Patil *et al.* (2018); studied in Jalna district of Maharashtra and Ganorkar *et al*. (2017) from Amravati district Maharashtra. The high quantity of accessible potassium on surface soil may be linked to the use of potassium fertilisers and the addition of manures (Solanki and Chavda 2012).

7. Boron: Boron as a micronutrient plays an important role in regulating plants' hormone levels, increase in leaf area, chlorophyll content, fruit set, fruit weight, total soluble solids (TSS), total acidity (TA) and promoting proper growth Sutanu Maji, *et al.* (2017); Kumar *et al.* (2018); Dhurve *et al.* (2018); Lateef *et al.* (2018). During the present investigation value of Boron lowest is 0.14% in sampling site V1 in November and highest value of Boron is 1.11 % reported at sampling site V3 in September. Boron is essential for plants to reduce fruit cracking and improve fruit yield and quality. During the present investigation available boron indicated that- similar to reported boron values range from 0.14% to 1.11 % in Maharashtra by Chavan (1974).

8. Sulfur: Sulfur (S) is required for the synthesis of amino acids, proteins, and chlorophyll, deficiency symptoms appear as a light green to yellow colour, occasionally ranging from extremely light yellow to virtually off-white. Plants with deficits have a slower growth rate. The results shown that the S value minimum reported as 10.76% at site V5 in January and maximum value of sulfur is 33.54 % reported at sampling site V7 in December. The obtained results of Sulfur (S) were similar to those previously reported by Thete (2019); Deshmukh *et al.* (2012); Shaikh (2006). The obtained results of Sulfur (S) were similar to those previously reported by Thete (2019); Deshmukh *et al.* (2012) from Sangamner taluka.

Table 1: Physico-chemical analysis of soil samples in the month of September and October 2019.

Sampling sites	September								October							
	pH	EC dsm^{-1}	C %	N (kg/hect)	P %	K %	B%	S %	pH	EC dsm^{-1}	C %	N (kg/hect)	P %	K %	B%	S %
V1	9.57	0.166	0.30	420.33	04.53	1490.40	0.70	28.43	8.57	0.167	0.34	426.49	03.26	1104.8	0.76	28.44
V2	7.34	0.120	0.32	215.40	15.08	560.70	0.80	18.69	8.32	0.118	0.22	206.34	10.52	582.4	0.89	17.69
V3	6.34	0.130	0.15	140.67	14.20	657.09	1.11	14.06	8.34	0.126	0.19	153.66	17.06	672.0	1.09	11.06
V4	7.50	0.144	0.33	310.19	07.25	653.6	0.95	23.12	7.88	0.133	0.43	304.19	15.24	694.4	0.71	23.12
V5	6.44	0.580	0.45	380.70	18.73	1151.6	0.63	13.18	6.74	0.670	0.55	388.86	6.53	1153.6	0.90	14.85
V6	6.50	0.150	0.59	203.75	16.11	836.8	0.75	14.15	7.00	0.200	0.61	203.84	19.23	851.0	0.63	18.64
V7	7.21	0.275	0.38	210.97	17.69	590.6	0.57	19.79	7.34	0.265	0.43	206.97	08.11	436.0	0.74	28.12
V8	7.15	0.265	0.25	308.20	17.26	590.6	0.52	20.75	7.30	0.250	0.49	247.74	16.69	660.0	0.54	16.11
V9	7.10	0.310	0.30	309.18	11.34	671.5	0.33	21.84	7.40	0.301	0.36	304.19	07.26	593.0	0.97	24.01
V10	7.30	0.380	0.75	320.75	13.75	472.4	1.05	13.57	7.25	0.373	0.63	316.73	12.34	470.4	1.03	12.95

Table 2: Physico-chemical analysis of soil samples in the month of November and December 2019.

Sampling sites	November								December							
	pH	EC dsm^{-1}	C %	N (kg/hect)	P %	K %	B%	S %	pH	EC dsm^{-1}	C %	N (kg/hect)	P %	K %	B%	S %
V1	7.68	0.160	0.28	424.26	04.20	1185.0	0.14	26.18	7.33	0.213	0.35	416.30	7.53	1251.8	0.83	33.54
V2	7.69	0.122	0.30	410.76	12.18	515.9	0.83	19.76	7.68	0.150	0.28	426.51	15.64	603.1	0.58	28.85
V3	7.68	0.130	0.17	449.63	15.39	670.0	0.95	13.55	7.31	0.180	0.20	435.85	17.28	695.3	1.03	10.93
V4	7.50	0.130	0.40	298.35	11.20	700.3	0.83	20.42	7.54	0.142	0.45	290.13	13.04	1090.6	0.85	25.71
V5	7.59	0.676	0.51	383.31	8.13	1160.5	0.70	12.38	7.26	0.588	0.58	395.06	11.29	906.9	0.43	15.68
V6	7.47	0.209	0.58	210.83	17.86	840.5	0.68	15.68	7.86	0.195	0.65	230.53	20.85	490.1	0.32	19.33
V7	7.47	0.260	0.41	215.26	10.35	432.4	0.63	25.87	7.14	0.306	0.78	241.65	18.98	643.3	0.81	20.29
V8	7.55	0.257	0.42	233.26	15.83	665.9	0.58	19.51	7.78	0.310	0.48	229.38	13.54	651.5	0.79	14.85
V9	7.76	0.300	0.35	295.68	09.36	681.8	0.42	23.12	7.53	0.280	0.29	310.26	7.68	590.8	1.09	29.68
V10	7.76	0.375	0.68	329.54	11.78	475.1	0.98	14.81	7.25	0.350	0.62	350.59	15.43	489.3	0.89	18.89

Table 3: Physico-chemical analysis of soil samples in the month of January and February 2020.

Sampling sites	January								February							
	pH	EC dsm^{-1}	C%	N (kg/hect)	P %	K %	B%	S %	pH	EC dsm^{-1}	C%	N (kg/hect)	P %	K %	B%	S %
V1	7.32	0.157	0.21	419.20	06.13	1138.9	0.63	30.10	7.63	0.174	0.25	417.53	5.51	1099.9	0.84	25.07
V2	7.58	0.130	0.45	420.45	09.09	495.10	0.54	17.63	7.74	0.117	0.28	410.76	8.03	488.4	0.51	18.51
V3	7.45	0.145	0.54	140.13	13.51	701.40	0.68	15.51	7.95	0.124	0.15	405.87	15.36	913.8	0.76	13.54
V4	7.51	0.532	0.36	258.51	08.36	750.50	0.91	23.54	7.36	0.136	0.58	217.33	10.45	735.9	0.36	22.81
V5	6.67	0.198	0.76	345.89	06.79	1303.3	0.83	13.83	7.58	0.430	0.17	310.28	9.54	1117.7	0.61	10.76
V6	7.72	0.280	0.49	199.52	15.83	785.70	0.89	22.95	7.45	0.187	0.51	187.45	13.13	676.8	0.16	21.33
V7	7.22	0.270	0.38	205.13	07.53	454.10	1.05	23.61	7.63	0.216	0.45	217.86	8.18	388.4	1.08	24.28
V8	7.54	0.285	0.43	220.59	17.29	674.80	0.55	16.43	7.22	0.245	0.73	198.43	14.54	710.8	0.45	14.14
V9	8.61	0.310	0.30	275.73	11.75	650.90	0.86	20.91	7.51	0.295	0.69	245.88	13.76	633.3	0.33	17.51
V10	7.29	0. 322	0.54	310.94	15.68	604.50	0.93	17.36	7.18	0.310	0.56	288.23	12.87	609.4	0.28	15.12

CONCLUSIONS

In this analysis, we examine the physicochemical properties of soil samples collected from pomegranate orchards in Sangamner and Rahata taluka. Sangamner and Rahata are geographically different but observed that both shown the similarity in soil colour and texture. All soil parameters, including pH, temperature, E.C, N, P, K, Carbon, and Sulfur are found within normal limits. This research provides information regarding the nature of soil and the nutrients that are found in soil of pomegranate orchads. According to the current study, the offered soil is more suited for the growth of pomegranate.

FUTURE SCOPE

This study will assist farmers of that location in determining the amount and kind of fertilizer and nutrients required for soil to boost crop yield percentage of pomegranates and other fruit crops also. This study provides effective soil management practices for nutrient availability via organic and inorganic fertilizer sources, which will help to improve soil health and crop production in the future.

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