

Physico-Chemical parameters of Soil Samples from Beed District

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Abstract—Soil quality play's vital role in agricultural processes and sustainability of ecosystem. Soil consists of organic matter, water, minerals, air, chemical salts and other materials. Healthy soil provides essential nutrients to plant and maintain environmental balance. The waste generated by human activities from transportation, construction, agriculture, domestic and industry make soil toxic. Soil is an uppermost loose layer of earth's crust which contains complex mixture of organic matter, minerals, water, gases, chemical salts, organisms, decaying organisms and other matter. The soil forms intermediate layer between the earth atmosphere, the lithosphere and rock cover.

In the present study, the different samples of soil collected from Kaij, Ambajogai, Parli Vajjnath, Majlagoan, Ashti and Gevrai Taluka of Beed district, Maharashtra and analyzed their physio-chemical parameters. The physico- chemical parameters like pH, temperature, electrical conductivity (EC), moisture contents, phosphates, carbonates, bicarbonates, water holding capacity were analyzed by using different methods available in the laboratory.

Index Terms—Physico-chemical parameters, pH, temperature, salts, organic matter, EC, carbonates and moisture.

I. INTRODUCTION

Soil is the uppermost loose layer of earth crust. It is formed through a slow process called pedogenesis. It takes thousands of years to form few centimeters layer of soil. The weathering process produces soil from parent rocks. There are mainly three types of weathering which converts parent rock to soil. i) The physical weathering in which parent rocks are converted to smaller particles due to rain, wind, thermal expansion and contraction and water freezing. ii) Chemical weathering in which parent rocks are converted to smaller particles due to water and gases. iii) Biochemical weathering in which parent

rocks are converted to smaller particles due to tree roots and lichens. The soil formation involves periodic weathering, addition of nutrients, microorganismic activities over a period of time.

The quality of soil and time required to form soil is depend on the nature of parent rock, climate conditions, types of living organisms and topography of area, biodiversity and human activities. India is a pluralistic country with a wide range of land types, climate and vegetation. India has diverse topography from north to south and east to west. Due to these various types of soil are found in different regions of India. These varied soil are significant in sustaining diverse agricultural activities, ecosystem balance and supporting economy. The factors like Climate, type of rock, natural vegetation and environmental factors determines the quality of soil. The soil contains 45-50% minerals, 20-25% water, 5-25% organic matter, 20-25% soil air and other material.

There are various methods of soil analysis. The physical methods like texture analysis, bulk density, particle density, water holding capacity, porosity. Chemical methods like pH, electrical conductivity, Olsen method, flame photometry. Biochemical methods like microbial biomass, soil respiration test, enzyme activity test and earthworm count test.

The testing of soil and nutrients analysis of soil helps farmers to optimize the use of fertilizers and soil management. Optimal use of fertilizers not only improves productivity of crop but also make farmers economically viable. It also helps to reduce the loss of nutrients and to mitigate soil pollution and maintain the soil rich with nutrients.

The location of this study area was Beed District, (M.S). The soil samples were collected from different locations of Kaij, Ambajogai, Parli Vajjnath, Majlagoan, Ashti and Gevrai Taluka of Beed. It is geographically site at 18.7271° N (18° 43' 37" N) and

18.7142° N (18° 42' 51" N) of Beed. Annual average rainfall is 396 mm with 29° C to 40° C annual temperatures. The soil in this region is derived from Deccan trap. The colour of soil is shallow to medium black and having good water holding capacity making it suitable for agriculture. The soil samples were collected from six different talukas of the Beed district by following appropriate process of soil collection samples.

Now a days farmers are facing problems of soil erosion, soil degradation, soil contamination and drought which ultimately mitigates the growth of crop plants and yield of crops. The present study is an attempt to analyze various soil samples from Kaij, Ambajogai, Parli Vajinath, Majlagoan, Ashti and Gevrai Taluka of Beed district, Maharashtra. This knowledge of physico-chemical analysis of soil will help farmers to use tolerable quantity of fertilizers which will enhance crop production and result in gaining economic stability.

II. METHODOLOGY

MATERIAL

Six soil samples were collected in glass bottle, one each from Kaij, Ambajogai, Parli Vajinath, Majalgoan, Ashti and Gevrai Taluka of Beed district, Maharashtra. The soil samples were collected from the depth of 1 to 20cm from the surface of soil in a month of January 2026. The soil samples were cleaned from herbs and solid waste. The collected soil samples were air dried and further dried in an oven at 30°C. The collected samples were numbered and brought in laboratory for analysis. The list of locations from the samples brought is as follows.

Table 1: List of locations from samples collected.

Sr. No.	Name of Location
1.	Ambajogai
2.	Kaij
3.	Parli Vajinath
4.	Majalgoan
5.	Ashti
6.	Gevrai

METHODS

The collected soil samples were subjected to further analysis. The pH of the samples was measured by using pH meter¹(Make Metravi PH-600). The

electrical conductivity of soil samples was measured in laboratory by using conductivity meter^{2,10}(Make Apex Lab EC-03). The soil temperature was measured by inserting meat thermometer (Make LABART ThermoPro TP01H) till the reading was stable.

Chlorides are highly soluble in water. Chloride contents were determined by Volumetric titrations with silver nitrate solution. Soluble chloride ions are extracted from the saturated paste of soil using for determination of pH and electrical conductivity. The suspension is filtered through Whatman's filter paper grade no. 42 to remove any suspended soil particles. The 10ml extract of soil is taken in Erlenmeyer flask. 4-5 drops of 5% potassium chromate added to it. The solution in flask is titrated against 0.01N AgNO₃ until the permanent reddish-brown color appear. Calcium carbonate (CaCO₃) is highly insoluble in water. It is determined by adding hydrochloric acid and titrating against NaOH using phenolphthalein as an indicator³⁻⁴.

Moisture is the amount of water present in the soil. The good quality soil contains appropriate amount of water. The moisture contents are determined by heating soil sample at specific temperature in an electric oven. Clean and dry container with lid having weight W₁ was taken. The known weight of soil sample was added in it. The container is heated in an oven at 105°-110°C for 1hr. The sample was cooled in a desiccator. After cooling it was weighed. The loss in weight of sample corresponds to weight of moisture. The moisture contents are also determined with the help of IoT based sensing system⁶.

The Organic matter is oxidised with strong oxidizing agents. Organic matter is oxidised with potassium dichromate using sulphuric acid. The unreacted potassium dichromate is titrated with Ferrous ammonium sulphate (FAS) solution⁷⁻⁸.

The water holding capacity (WHC) of water means how much water can absorb the soil sample⁹. To measure the water holding capacity, 25gm dry air free sample of soil was taken in a funnel with Whatman No. 40 filter paper. The funnel is placed into a graduated cylinder. Slowly 50ml water was added and stand for 1hr to percolate water. Percolated water was collected in 100ml beaker. The percolated water again added in sample. This process repeated three time. The top of the funnel is covered and soil sample is allowed to stand for overnight. From the volume of water

retained, the percentage of water holding capacity (WHC) is calculated as follow.

% of WHC

$$= \frac{\text{Volume of water retained by soil}}{\text{Weight of Soil}} \times 100$$

Alkalinity is the capacity of soil to neutralize strong acid. The soil possesses alkalinity (PA) due to soluble salts of carbonates, bicarbonates and phosphates¹⁴. Paste of soil sample was taken in a conical flask. Added 2-3 drops of phenolphthalein indicator. If the solution remains colourless, PA=V1=0 and TA is determined. If colour changes to pink after addition of phenolphthalein, titrate it with 0.1N HCl until pink colour gets disappeared. This is PA. Now added 2-3 drops of methyl orange indicator to the same sample and continued titration until yellow colour changes to pink. This is TA.

III. RESULTS AND DISCUSSIONS

PHYSICAL PARAMETERS

The six samples collected from each region of Kaij, Ambajogai, Parli Vajjnath, Majalgaon, Ashti and Gevrai Taluka of Beed district and analysed for physical parameters like pH, Temperature, Moisture and Water holding capacity. The results are shown in table No.2.

The pH of soil is very important property to grow the crop. The pH value of soil samples collected had a range from 7.08 to 8.05. The pH value of acidic soil is < 6.5. The pH of normal soil ranges from 6.5 to 7.5. Alkaline soil having pH > 7.5.

The temperature of soil also plays a responsible role for evaporation of water which is also important for water holding capacity of soil. The good quality soil has optimum temperature range of 18°C to 23°C. The temperature ranges from 20°C to 22.10°C shows that the soil is good for agriculture. The electrical conductivity of soil depends on nature and number of salts carrying the soil. The electrical conductivity (1.547-3.342 µS/cm), moisture (5.583-6.823%) and water holding capacity (0.20-0.40) range shows soil possesses adequate quality to grow crops.

Table No. 2: Physical parameters of six different locations of Beed.

Sr. No.	Name of Location	Temperature (°C)	pH	WHC (mg/g)	Moisture Contents %	EC (µS/cm)
1.	Ambajogai	21.04	7.83	0.33	6.476	1.753
2.	Kaij	21.08	7.49	0.24	5.823	1.547
3.	Parli Vajjnath	20.01	8.01	0.39	5.045	1.894
4.	Majalgaon	22.10	7.79	0.20	7.216	3.342
5.	Ashti	22.01	7.65	0.28	6.103	2.732
6.	Gevrai	20.00	8.05	0.40	7.583	2.412

IV. CHEMICAL PARAMETERS

Chemical constituents of soil are very important to increase crop yield. The six samples collected from six

talukas of Beed district were analyzed for organic matter, carbonates, bicarbonates, chloride contents and alkalinity. The results of chemical parameters are shown as below.

Table No. 3: Chemical parameters of six different locations of Beed.

Sr. No.	Name of Location	Organic Contents (%)	Carbonates (ppm/l)	Bicarbonates (ppm/l)	Chloride (mg/l)	Alkalinity (meq/l)
1.	Ambajogai	4.57	11	4	0.3725	400
2.	Kaij	2.29	9	7	0.3841	450
3.	Parli Vajjnath	5.61	15	4	0.4869	350
4.	Majalgaon	6.21	18	6	0.4631	390
5.	Ashti	1.80	8	3	0.3082	500
6.	Gevrai	3.20	20	5	0.4021	309

The organic matter is formed by decomposition of plants and animals in presence of microorganisms. The high contents of organic matter are beneficial to grow crops. Organic matter increases water holding capacity, air circulation and nutrients of the soil. The organic matter ranges from 6.21 to 1.80 % which is adequate to grow crops. The carbonates and bicarbonates act as binding agents in the soil. The carbonate and bicarbonate contents ranges from 20-

8ppm/l and 7-3ppm/l respectively¹⁷. The values show that soil is slightly sandy and moderately calcareous. Alkalinity ranges from 309 to 500 meq/l which show that the soil samples possess normal alkalinity¹⁸. The chloride contents 0.3082 to 0.4869 mg/l. The chloride contents are highly soluble and important in photosynthesis in plants. All the samples content showed low concentration of chemical parameters.

V. GRAPHICAL REPRESENTATION OF PHYSIO CHEMICAL PROPERTIES

PHYSICAL PARAMETERS:

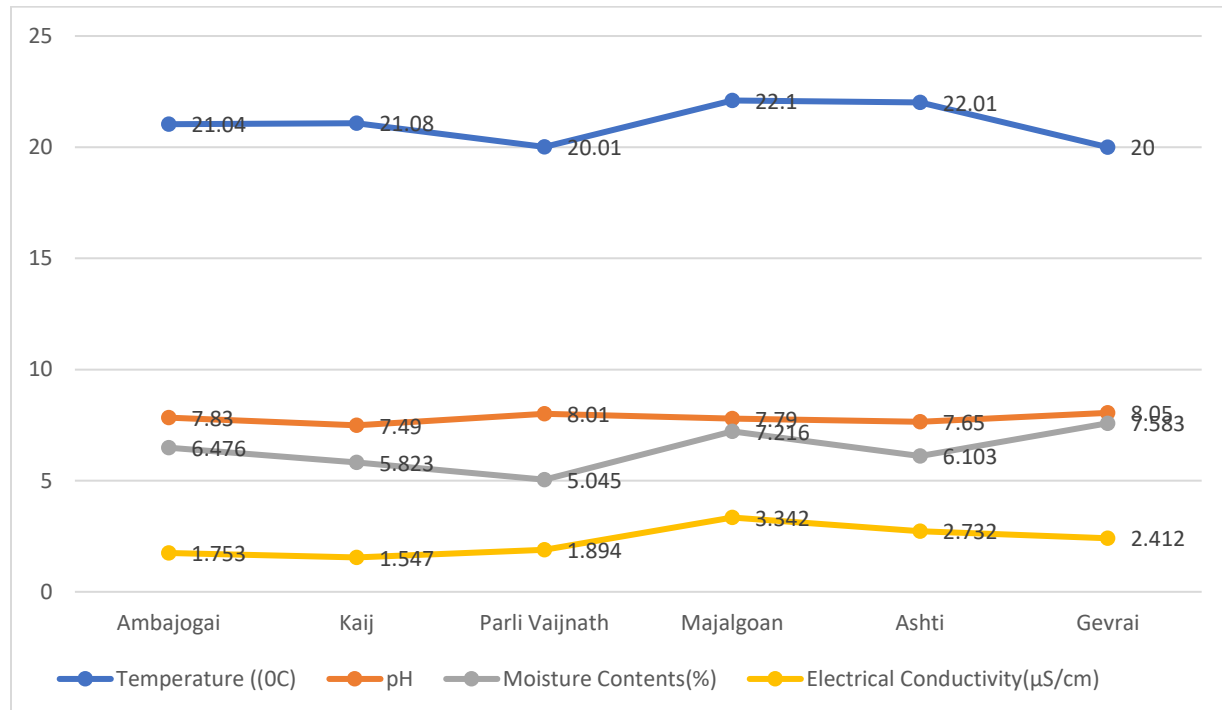


Fig.1. Graphical Representation of Temp, pH, Moisture Contents, EC

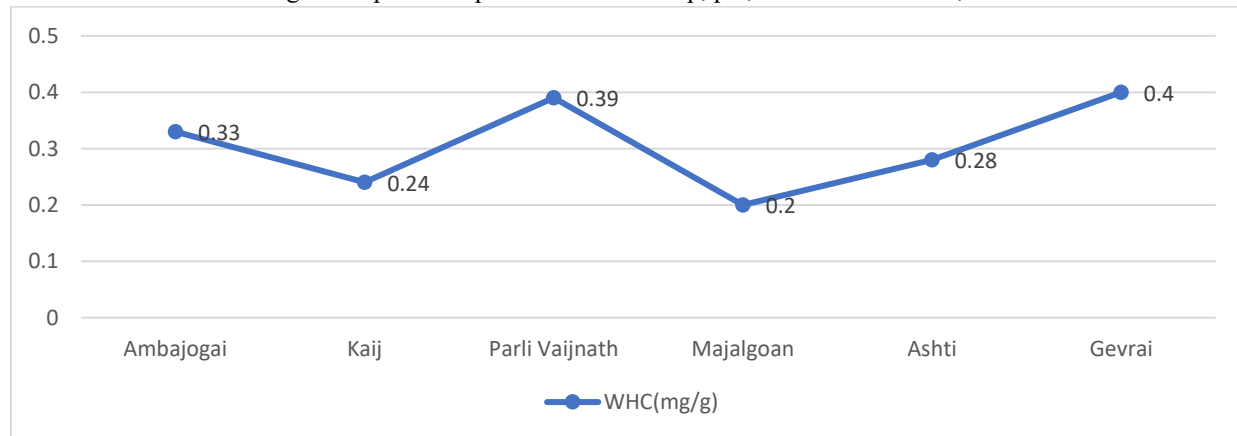


Fig.2. Graphical Representation of WHC of soil

VI. CHEMICAL PARAMETRS

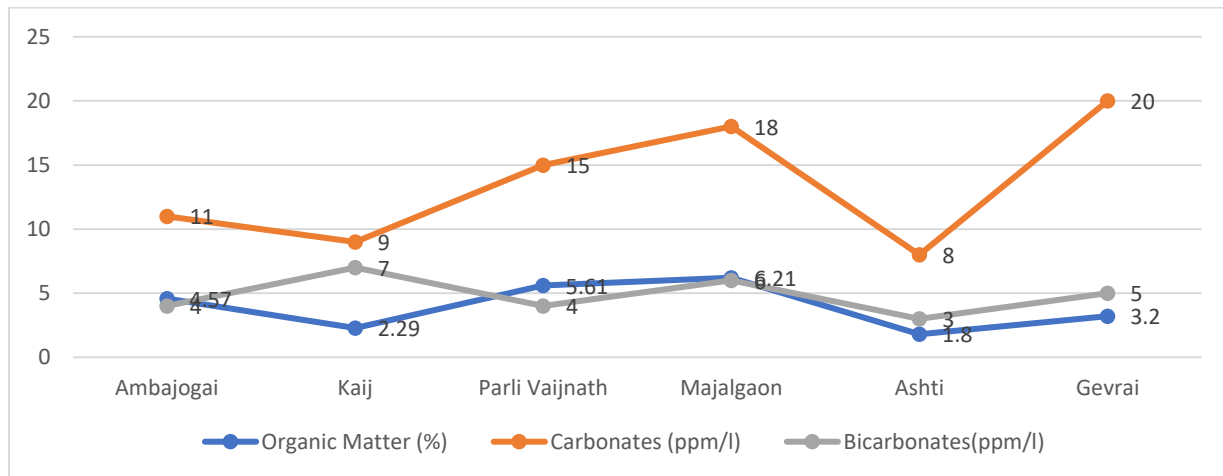


Fig.3.Graphical Representation of Organic Matter, Carbonates and Bicarbonates

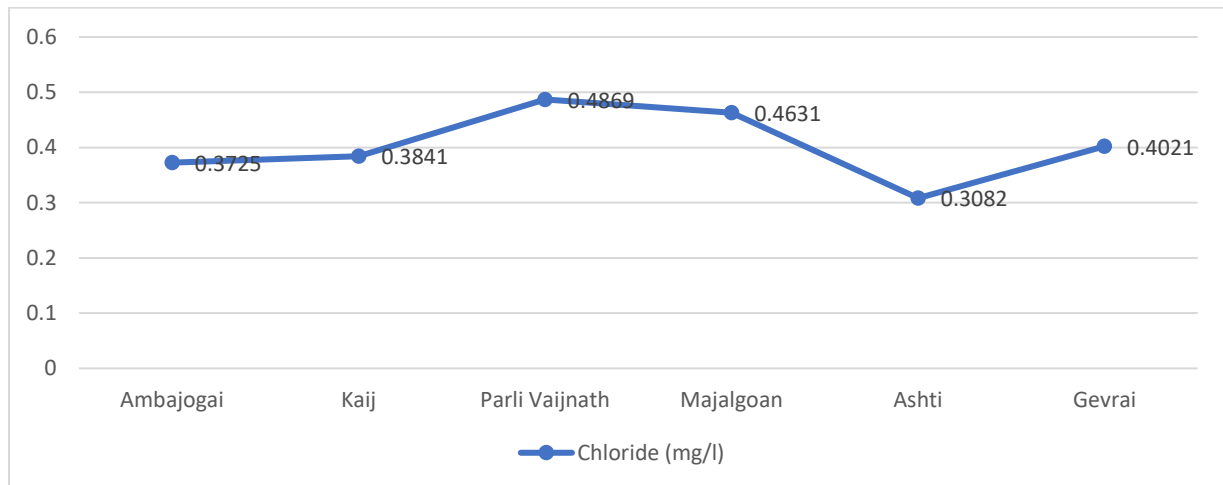


Fig.4.Graphical Representation of Chloride of Soil

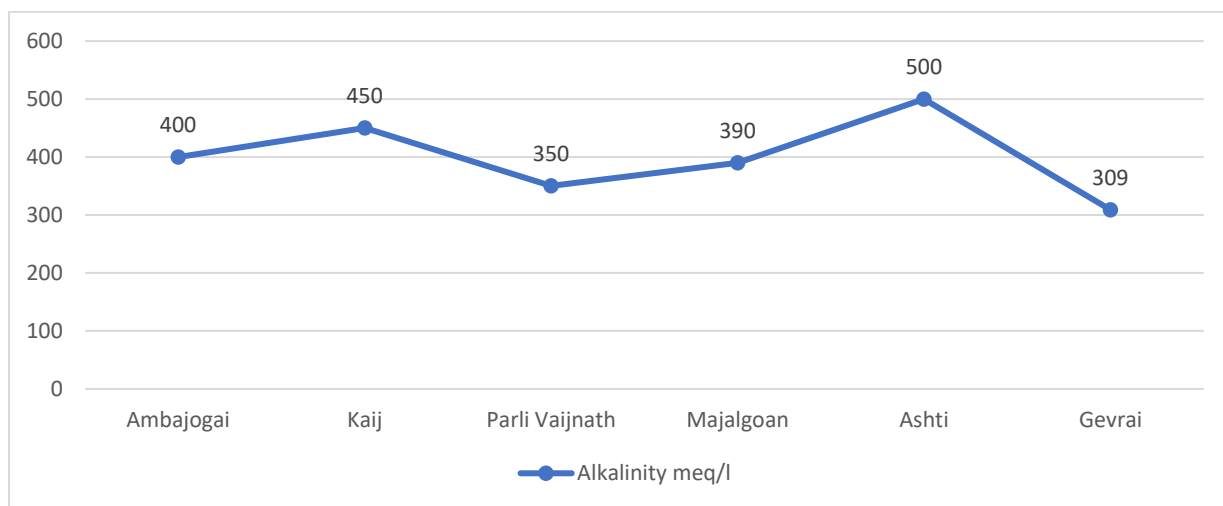


Fig.5.Graphical Representation of Alkalinity of Soil

VII. CONCLUSION

The present study results of six locations show some variation in properties. The pH (7.08-8.05) of soil samples is neutral to slightly alkaline which is favourable for cultivation of many crops. The physical parameters like Soil temperature (20°C -22.1°C), moisture contents, water holding capacity, electrical conductivity were found in an acceptable range indicating suitable physical conditions for growing crops. The chemical parameters indicate adequate level of organic matter, moderate carbonates and bicarbonates range, normal alkalinity and low chloride contents. These chemical parameters suggest that the soil samples from all six locations carries satisfactory fertility and possess good potential for sustainable agriculture production. However, the variation in organic matter and alkalinity indicates need of soil management practices. Our study shows that soil samples of Beed district have sufficient amount of soil nutrients. The periodic monitoring physico chemical parameters of soil testing will assist farmers to use of fertilizers, enhance productivity and promote sustainable farming practices.

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