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RESEARCH ARTICLE

EVALUTION OF PHYSICO-CHEMICAL CHARACTERISTICS OF SOIL SAMPLES COLLECTED FROM SANTALPUR TALUKA OF PATAN DISTRICT (NORTH GUJARAT)

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Abstract

Assessment of soil Quality of Santalpur taluka of at Patan district (North Gujarat, India) was undertaken. Different types of crops are taken at North parts of Gujarat. The survey includes many fields and surface soil sample up to depth 5-10 cm were collected and after drying were passed through 2 mm sieve. The soil samples were analyzed for various physico-chemical parameters like pH, electrical conductance, organic carbon, nitrogen, phosphorus and potash content. Nitrogen, phosphorus and potassium are essential components of every living organism. In plants, nitrogen deficiency causes stunted growth and chlorosis or yellowing of the leaves due to decreased leaves of chlorophyll. Potassium deficiency may causes necrosis or interveinal chlorosis while excess potassium may cause deficiencies in magnesium and possibly calcium. Phosphorus is an important nutrient in crop production, since many soil in their native state do not have sufficient available phosphorus to maximize crop yield.
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Keywords: Soil quality, Santalpur Taluka, North Gujarat.

Introduction

Soil is the unconsolidated mineral on the surface of the earth that serves as a natural medium for the growth of plants. It is formed from rocks by physical, chemical and biological weathering [1]. Soil consists of various constituents such as minerals, organic matter, water and air [2,3]. Warren and Agnew[4] described that, of the threats to sustainability, the threat due to soil fertility depletion is the most serious. Depending upon the cropping pattern, leaching, erosion etc, soil losses a considerable amount of nutrients every year. If the cropping pattern is continued over a period of time without nutrients being restored to the soil, its fertility will be reduced and crop yields will decline. This happens because 90% of plant available N, 50-60% K, 25-30% P and almost 70% micronutrients residue in organic matter [5].

Soil testing provides information regarding nutrient availability in soils which forms the basis for the fertilizer recommendations for maximizing crop yields. Several elements take part in the growth and development of plants, and those absorbed from the soil are generally known as plant nutrients. Major nutrients are carbon, hydrogen, nitrogen, phosphorous and potassium. Secondary nutrients are calcium, magnesium and sulfur and micro – nutrients are iron, manganese, boron, zinc, copper, molybdenum and chlorine. Obviously, a soil fertility map for a particular area can prove highly beneficial in guiding the farmers, manufacturers and planners (associated with fertilizer marketing and distribution) in ascertaining the requirement of various fertilizers in a season/ year and making projections for increased requirement based on cropping pattern and intensity.

Characteristics of the site

The Patan district is one of the important districts of Gujarat because of horticultural crops like spices,

fruits (mainly mangoes, Ber, Guava, Aonla, Custered apple, Jamun, Tamarind etc.). The average rainfall is good, between 475 mm to 697 mm. About 45% of the cultivable land are covered by Kharif crops. 50% of the area under Kharif crops are covered by 3 main crops (24% - Bajra (*Pennisetum glaucum*), 15% - Cotton (Gossypium herbaceum) and 10% - Castor *(Ricinis communis*). About 40% of the cultivable land are covered by Rabi crops. 83% of the area under Rabi crops are covered by 4 main crops (34% - Mustard *(Brassica Nigra*), 21% - Wheat (*Triticum*) and 16% - Cumin (*Nigella sativa*).

The soil condition is of great importance, because it is universal medium for plant growth, which supplies essential nutrients to the plants.

Materials and methods

Total 13 villages of Santalpur taluka of Patan District , Gujarat were selected for the collection of the soil samples during period of 2012. From the selected sites, samples were collected as per procedure described in methods manual, soil testing in India [6]. The soil samples were dried in oven at 60 ^{0}C and passed through ~2mm mesh sieve, stored in polythene bags.

All the reagents and chemicals used were of A.R. grade procured from E. Merck , BDH . All the solutions of standards and samples were prepared from deionized water.

Physico-chemical parameters of soil samples like pH was determined in 1:2.5 soil-water suspension [7] . Electrical conductivity (EC) was determined 1:2 soil -water suspension using conductometer [8].Total Nitrogen was determined using Kjhedal method[7] and available Phosphorus analysis was done by sodium bicarbonate method using colorimeter[9] and Available potassium was determined with ammonium acetate using Flame Photometer [8]. Organic Carbon was determined by using Walkley-Black method [10].

Results and Discussion

Available nutrient status in the soil is generally classified as low, medium and high which are generally followed at the National level and are as follows (Table : 1)[11].

The physico-chemical characteristics are given in Table-2, revealed that, soil was clay in texture which is considered to be quite fit for crop growing. The pH values of the soil samples ranged from 7.04 to 8.29 with a mean value of 7.92 which is considered as moderately alkaline.

pH is an important property of soil that determines the acidity or alkalinity, which effects the chemical reactions between water and soil minerals [12]. pH of all the soil samples was found within the permissible limits (Table-2). There is a strong relationship between soil pH and nutrient availability. Alkaline soils with pH ranging 7-8 are generally deficient in Zn^{2+}, Fe^{3+}, P^{5+} and also uptake of various plant nutrients is pH depended [13]. Most of the primary nutrients like nitrogen, phosphorous, potassium and secondary nutrients like calcium ,magnesium and sulfur are best utilized by the plants when the pH range is 5.5 -7.9. The uptake of most of the micronutrients also take place at low pH [14].

The electrical conductivity (EC) is a measure of the ionic transport in a solution between the anode and cathode. The increased electrical conductivity (EC) values were observed in the range of 0.135 to 3.150 ms/cm with a mean value of 1.343 ms/cm (Table-1) whereas the permissible limit is 4 ms/cm [15]. The increase in EC value may be due to agricultural run off and accumulation of salts [16]. Available nitrogen content in the fields ranged from 0.460 to 0.650 % with a mean value of 0.558. Lower nitrogen values recorded for sample S19 and higher value was recorded for S39. The higher available nitrogen content in the soil is due to application of fertilizers. Nitrogen supply largely controls the growth and fruiting of most plants.

In the present study organic carbon was found in the range of 0. 44 % - 0.63 % with a mean value of 0.53. Walkly [17] studied and interpreted the results of percentage organic carbon as follows:

Very low	> low	> medium	> medium high	> high
0.20	0.21-0.40	0.41-0.60	0.61-0.80	0.80

So according to above standards the soils of study area is found to be placed in the class of medium as an average.

The available phosphorus in the soils ranged from 3.7 to 21.2 kg/ha with a mean value of 12.4 (Table-2). Available P content was medium at some sites in the study area where pH was neutral. The near neutral pH have a significant role in enhancing P availability. At some places phosphorus was high, which may be due to different nutrient management practices among the farmers [18]. Phosphorous

Table:1 Soil Fertlity index.

Sr. No.	Soil Nutrients	Soil Fertility Ratings		
		Low	Medium	High
1	Organic carbon as a measure of available Nitrogen (%)	< 0.5	0.5 –0.75	> 0.75
2	Available P b method (kg/ha) in Alkaline soil	< 10	10 –24.6	>24.6
3	Available K by Neutral N, ammonia acetate method (kg/ha)	< 108	108 - 280	>280

Table 2. Physicochemical parameters of soil of Santalpur taluka of Patan District.

Sample No.	C Organic Carbon	% N	K (K_2O) kg/ha	P (P_2O_5) kg/ha	pH	EC (ms/cm)
S1	0.55	0.570	650	12.9	8.10	0.542
S 2	0.46	0.480	443	18.5	8.13	2.680
S 3	0.62	0.640	472	9.2	8.05	0.148
S 4	0.58	0.600	413	14.8	8.10	0.278
S 5	0.63	0.641	502	9.2	8.13	0.497
S 6	0.47	0.490	620	11.0	8.12	0.723
S 7	0.60	0.620	443	14.8	8.10	0.318
S 8	0.55	0.570	709	14.8	7.20	0.418
S 9	0.53	0.550	591	12.9	7.82	0.589
S 10	0.61	0.630	709	11.8	7.48	3.150
S 11	0.48	0.500	354	9.2	8.18	0.312
S 12	0.53	0.550	739	9.2	8.12	0.840
S 13	0.62	0.645	591	12.9	8.16	0.326
S 14	0.56	0.580	443	16.6	8.20	0.778
S 15	0.47	0.490	532	3.7	7.70	0.543

S 16	0.52	0.540	354	18.5	7.96	2.180
S 17	0.54	0.560	798	11.5	7.58	0.523
S 18	0.51	0.530	620	11.2	7.76	1.612
S 19	0.44	0.460	650	11.1	7.92	3.010
S 20	0.53	0.550	266	14.8	8.25	0.482
S 21	0.52	0.510	502	9.2	7.90	0.237
S 22	0.55	0.570	561	12.5	8.14	0.322
S 23	0.46	0.480	177	12.9	8.13	1.181
S 24	0.50	0.500	443	5.5	8.20	0.177
S 25	0.57	0.590	354	9.2	8.28	2.480
S 26	0.53	0.550	620	9.2	8.25	0.135
S 27	0.51	0.530	739	14.8	8.29	2.810
S 28	0.55	0.570	650	14.9	8.14	0.618
S 29	0.49	0.510	709	14.6	8.16	2.010
S 30	0.46	0.480	620	20.3	8.20	2.330
S 31	0.60	0.620	710	16.6	7.90	2.960
S 32	0.56	0.580	650	12.9	8.12	2.180
S 33	0.62	0.640	561	14.8	8.05	1.900
S 34	0.53	0.550	532	21.2	8.12	2.360
S 35	0.47	0.490	591	14.9	7.56	1.780
S 36	0.52	0.540	502	14.5	7.62	1.960
S 37	0.59	0.610	512	12.9	7.26	2.050
S 38	0.60	0.620	591	7.4	7.15	2.360
S 39	0.63	0.650	472	14.8	7.17	1.895
S 40	0.52	0.540	413	7.4	7.04	2.090
S 41	0.49	0.510	502	12.9	7.11	2.110
S 42	0.54	0.560	620	9.2	8.23	0.998
S 43	0.57	0.590	650	5.5	8.15	1.980
S 44	0.61	0.630	532	12.9	8.18	0.321
S 45	0.50	0.520	443	11.1	8.20	1.250

remains as free Phosphate or bound to organic compounds as esters in plants [19]. Phosphorous is important in plant bioenergetics. It is an important constituent of protoplasm as it is essential constituent of nucleic acids, phospholipids and numerous phosphorylated compounds. Phosphorous can also be used to modify the activity of various enzymes by phosphorylation, and can be used for cell signaling.

Data pertaining to available potassium ranged from 177 to 798 kg/ha with a mean value of 547 (Table-2). These values are high according to manual [11].The available potassium content was high in sample S17. In highly weathered soils, strong weathering had reduced potassium content. Potassium is the major nutrient after nitrogen and phosphorous which is considered essentials for the plant growth. Potassium is an enzyme activator that increases photosynthesis and reduce crop loading [20,21].

Conclusion

The present study revealed that the pH of soil of Santalpur taluka was moderately alkaline (ranged from 7.04 to 8.29), Electrical conductivity was medium (ranged from 0.135 to 3.150 ms/cm) , Organic Carbon content was medium (ranged from 0.44 to 0.63 %), Nitrogen content was low (ranged from 0.460 to 0.650 %) , Phosphorous content was medium (ranged from 3.7 to 21.2 kg/ha) and Potash was high (ranged from 177 to 798 kg/ha). So, overall the soil fertility indices are satisfactory from the point of view of agriculture.

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