Studies on Some Physicochemical Parameters of Soil Samples in Santalpur Taluka, District Patan, Gujarat, India

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Abstract:

Soil is an important vital component, medium of unconsolidated nutrients and materials, forms the life layer of plants. The physicochemical parameters of soil determine their adaptability to cultivation. The present work has been carried out to study some parameters of soil samples collected from Santalpur Taluka, District Patan. Five representative locations were selected for the study and 20 samples from each location and direction of area were collected The soil characterization was carried out for the parameters like pH, Electrical conductivity, organic carbon, available potash, calcium, magnesium, sulphur, phosphorous, copper, iron, manganese and zinc. Low, medium & high range of all parameter also calculated from analysis data. The variations of amount of nutrients were observed in the soil due to different places. This information will be helpful to the farmers to solve the problems related to soil nutrients amount of which fertilizers to be added to soil to increase the yield of crops.

Keywords: Component, Nutrients, Characterization, Electrical conductivity.

Introduction:

Soil testing refers to the chemical analysis of soils and is well recognized as a scientific means for quick characterization of the fertility status of soils and predicting the nutrient requirement of crops [1-5]. It also includes testing of soils for other properties like texture, structure, pH, Cation Exchange Capacity, water holding capacity, electrical conductivity and parameters for amelioration of chemically deteriorated soils for recommending soil amendments, such as, gypsum for alkali soils and lime for acid soils**.** One of the objectives of soil tests is to sort out the nutrient deficient areas from non-deficient ones. This information is important for determining whether the soils could supply adequate nutrients for optimum crop production or not. Soils testing take the guesswork out of mainting the soil in optimum condition for plant growth and developments. Different plants have different soil pH and nutrient requirements. Testing is inexpensive when compared to investments in yours plants, amendments, time and efforts. The Fertilizer guidelines provide with the soil test results are based on environmentally-friendly soil fertility management's practices. A soil test will assess the present's levels of major plant nutrients, soil pH, micronutrients and provide an estimate of total soil lead. Recommendation will include the amounts of limestone and fertilizer, if necessary, to meet the requirements of the specific plant or crop being grown. If elevated soil lead levels are indicated, appropriate information will be including with your results to

address this problem. Different studies have shown that the most of the plant nutrients are optimally available to plants at pH range between 6.5 to 7.5 ranges [5-7]. There are 17 essential nutrients which are required for plant growth.

Phosphorous is an essential element for plant growth and is often applied to agricultural land to increase crop production. Through soil phosphorous testing, the amounting of phosphorous fertilizer required to achieve maximum plant grow can be determined. Soil with low or medium phosphorous content will likely show higher yields if extra phosphorous is added. However, crops are not likely to respond with a yield increase in soils with high or very high phosphorous content. Agricultural nutrients such as potassium (K), magnesium (Mg), and Calcium (Ca) are very important for plants growths and development. The analysis of these nutrients elements is thus helpful in assessing the fertility of the soil and improving soil quality prior to planting or during crop growth. Many researchers have made attempt for analysis of soil samples from different sites to know the fertility status of soil [8-12].

The soil test aimed at soil fertility evaluation with resulting fertilizer recommendation is, therefore, the actual connecting link between the agronomic research and its practical application to the farmers' field. Soil testing can be divided into four steps (1) sampling (2) analysis (3) interpretation and (4) recommendations. One of the most important aspects of soil testing is that of obtaining a representative sample of the area.

Plant Nutrients

Although plants absorb a large number of elements, all of them are not essential for the growth of plant. The elements which are required by plant for their normal growth, development, metabolism and to complete their life cycle are called the essential ones. Some of these are required in large amounts and some in traces. Nutrients are classified as Primary (Macro), Secondary and micro, and are further classified as follow:

Major nutrients required for plant growth

Class 1: Carbon, hydrogen and oxygen (C, H, O).

Class 2: Nitrogen, potassium and phosphorus.

Secondary Nutrients: Magnesium, Calcium and sulphur

Micro nutrients: Iron, boron, zinc, molybdenum, manganese, copper and chlorine.

Soil testing can be divided into four steps (1) sampling (2) analysis (3) interpretation and (4) recommendations. One of the most important aspects of soil testing is that of obtaining a representative sample of the area.

CHEMICAL & EQUIPMENTS

Potassium chloride, Buffer tablate, Sulphuric acid, Potassium dichromate, Sodium bicarbonate, activated charcoal (phosphorous free), Ammonium molybdate, Stannous chloride, Ammonium acetate, Calcium chloride, Glacial acetic acid, Barium chloride, Gum acacia, Sodium diethyl dithiocarbomate, Sodium hydroxide, Muroxide, Ethylene di amine

tetraacetate, Ammonia buffer, Diethylenetriamine pentaacetic acid, Eriochrome black-T, were procured from s.d. fine chem Ltd. All chemicals are of analytical grade reagent.

pH was measured on pH meter (systronics Model No-335), Conductivity was measured on conductivity meter (systronics Model No-304), Optical density was measured on colorimeter (systronics Model No-202), Analytical balance (Wensar Model No-PGB200) was used to weigh samples and reagents, Flame photometer (systronics Model No-128) was used for analysis of Potash, Micro Nutrients was analyzed on Double beam atomic absorption spectrophotometer (Elico Model No-SL 194).

METHOD OF ANALYSIS:-

(1) pH

10 g soil & 20 ml distilled water were taken in 50 ml beaker & stirred for 30 min. In 50 ml beaker taken 10 g soil and added 20 ml distilled water and stir for 30 min. Adjusted the temperature of pH meter at 25 ^{0}C. Calibrated the pH meter using 4, 7.0, 9.2 pH buffer solution. Washed the electrode with distilled water and clean by filter paper. Immerses electrode in above suspense solution and note the reading.

(2) Potassium

Method for graph factor of Potassium

Prepared following stock solution and from it make various potash ppm solutions and run in flame photometer and note down potash ppm the reading.

Table No-1: Reading for Standard Graph of Potassium

Flask No.	Stock solution	Concentration of Pottash in 100 ml Volumetric Solution (ppm)	Reading of Flame Photometer
1	0.0ml (Blank)	----------	0
2	1.0ml	10ppm	38
3	1.5ml	15ppm	47.5
4	2.0ml	20ppm	54.5
5	2.5ml	25ppm	64.5
6	3.0ml	30ppm	74
7	4.0ml	40ppm	96
	Total	140ppm	374.5

Calculation

1 Reading = Total Solution of ppm / Total Reading
=140 / 374.5
= 0.374

1 Gram Soil = R X 0.374 X 5 Microgram K / Gram Soil (0.374 Graph Factor)
R= Flame Photometer Reading of sample

K
Kg/Hectare = R X 0.374 X 5 X 2.24 (2.24 = Factor in **K** Hectare)

K_2O
Kg/Hectare = R X 0.374 X 5 X 2.24 X 1.20 (1.20 = Factor in **K_2O** Hectare)
= R X 5.026

Process:

5 g soil sample was taken in 100 ml conical flask. 25 ml 1 M neutral ammonium acetate solution was added. Shaken it for 5 minutes on shaking machine and filtered the solution on whatman filter paper. Flame photometer was calibrated by using 10, 20, 30, 40, 50, 60, 70, 80 and 90 ppm standard potassium solution. After calibration run above filtrate for analysis and note down the reading.

(3) Calcium

5 g air dried soil sample was taken in 150 ml conical flask and 25 ml of neutral normal ammonium acetate was added. Shaken it on mechanical shaker for 5 min, and filtered through Whatman filter paper No.1. 10 ml filtrate solution was taken in conical flask, and 2-3 crystals of sodium diethyl dithiocarbamate were added. Then 5 ml 16% sodium hydroxide and 40-50 mg of the murexide indicator were added. Titrate it with 0.01N EDTA solution till the color gradually changes from orange red to reddish violet (purple), note the titrated EDTA solution.

(4) Electrical Conductivity (E.C.)

10 g soil and 20 ml distilled water were taken in 50 ml beaker. It was stirred for 30 minutes. The temperature of E.C. meter was adjusted at 25 ^{0}C then conductance was adjusted to 1.412 mS/cm by using 0.01 N KCl solution. Washed the electrode with distilled water and cleaned with filter paper. Immerses electrode in above suspense solution and note the reading.

(5) Phosphorus

Method for making standard graph for phosphorus.

0.439 g previously dried potassium dihydrogen orthophosphate was dissolved in 500 ml distilled water and 25 ml 7.0 N Sulphuric acid solution was added and then makes up 1 Ltr by using distilled water. 10 ml above solution was taken and makes up 500 ml by using distilled water (1 ml this resulting solution is equivalent to 2 ppm of phosphorus). By using this

solution, various standard phosphorus ppm solutions were prepared and measured and their optical densities (O.D.) were measured by using red filter.

Table No-2: Standard Graph of Phosphorous

Flask No.	**2 ppm Working Solution of Phosphorous**	**8.5 pH Solution of Sodium Bicarbonate**	**1.5 Percentage Solution of Ammonium Molybdate-HCl**	**Working Solution of Steanus Chloride**	**O.D.**
1	0 Blank	5 ml	5 ml	1 ml	0
2	1 ml = 2 ppm	5 ml	5 ml	1 ml	22
3	2 ml = 4 ppm	5 ml	5 ml	1 ml	36
4	3 ml = 6 ppm	5 ml	5 ml	1 ml	57
5	4 ml = 8 ppm	5 ml	5 ml	1 ml	81
6	5 ml = 10 ppm	5 ml	5 ml	1 ml	103
7	10 ml = 20 ppm	5 ml	5 ml	1 ml	197
	Total = 50 ppm				496

Calculation

1 Reading

= Total Solution of ppm / Total Reading
=50 / 496
= 0.101
0.1010 Microgram P (Graph Factor)

1 Gram Soil = R X 0.1010 X 4 Microgram P/ Gram Soil
R =Colorimeter Reading of Sample 0. 1010= Graph Factor
P (Kg/ Hectare) = R X 0.1010 X 4 X 2.24 (2.24 = Factor in 'P' Hectare)
P_2O_5 Kg/ Hectare = R X 0.1010 X 4 X 2.24 X 2.29 (2.29 = Factor in 'P_2O_5 ' Hectare)
P_2O_5 Kg/ Hectare = R X 2.0723584

Process:

2 g soil sample and 40 ml 0.5 M sodium bicarbonate (8.5 pH) solution were taken in 100 ml beaker. To this, 1 g phosphate free activated charcoal was added and shaken on shaker for 30 minutes. The solution was filtered and pipette out 5 ml. 5ml 1.5% ammonium molybdate-hydrochloric acid solution was added to this solution. Allow to stand for 30 minutes, then 1ml 0.016 M stannous chloride solution was added & make up 25 ml using distilled water. Blank solution was prepared according to the above process without taking the soil sample. Red filter was used and zero optical density was set by using above blank solution, then put the above sample solution and note the optical density.

(6) Carbon

Method for making standard graph for Organic carbon.

Weighed out 1.25 g sucrose and taken it into 250 ml of volumetric flask and dissolved in 1 N of potassium dichromate solution, and makes up 250 ml volume by using 1 N potassium dichromate. 7 glass beakers of 50 ml were taken and numbered from 1 to 7. 0 ml, 1 ml, 2 ml, 3 ml, 4 ml, 5 ml and 6 ml solution was taken into above beakers from prepared solution of potassium dichromate. Taken 10 ml 1 N potassium dichromate solution and 20 ml conc. sulphuric acid in test-tube and placed for 30 minutes. Allowed to cool and added 20 ml distilled water. Prepared following different standard carbon ppm solution and measured optical density (O.D.) by using red filter.

Table No-3: Reading for Standard Graph of Carbon

Sr. No.	ml of sucrose solution diluted in potassium dichromate	Amount of sucrose	O.D.
1	0 (blank)	----------	0
2	1	0.005 g	27
3	2	0.010 g	64
4	3	0.015 g	96
5	4	0.020 g	121
6	5	0.025 g	155
7	6	0.030 g	182
	Total	0.105 g	645

Calculation:-

1 Reading

1 Reading = Total Amount of Sucrose / Total Reading
= 0.000162791
= 0.000161043 g Sucrose

1 Reading Carbon value:

0.00006837
0.00006764 gram organic carbon

1 Reading Graph Factor Value = 0.000067638 X 100
= 0.0067638

Process:

Taken 1.0 g soil sample in 100 ml beaker. 10 ml 1 N Potassium dichromate solution and 20 ml conc. Sulfuric acid were added to the sample and cooled the solution for 30 minutes. 20 ml distilled water was slowly added and allowed for 12 hrs for oxidation. Then first set zero optical density using blank solution (as above method without taking soil sample). Measured optical density (O.D.) of soil sample by using red filter and note down the reading.

(7) Magnesium

5 g air dried soil sample was taken in conical flask. To this, 25 ml of neutral ammonium acetate solution was added. The solution was shaken on mechanical shaker and filtered through Whatman (No.1) filter paper. 5 ml solution was pipetted out in conical flask. To this solution, 2-3 crystal sodium diethyl dithiocarbamate, 5 ml of ammonium chloride-ammonium hydroxide buffer solution and 3-4 drops of Eriochrome black-T indicator were added. Titrated it slowly against 0.01 M EDTA solution. At the end point color changed from wine red to blue.

(8) Sulphur

Method for making standard graph for Sulphur

Weighted out 5.434 g potassium sulphate and make up 1 Ltr by using distilled water (this solution contains 1000 ppm of sulphur). 25 ml this solution was taken and make up 1 Ltr with distilled water (this is working standard solution of sulphur). Taken 0.0 (Blank), 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, and 10 ml working solution in 25 ml volumetric flask. In every flask 1.0 g barium chloride and 1 ml gum acacia solution were added, and make up 25 ml by using distilled water. Then optical density of blank solution was set to zero using blue filter.

Table No-4: Reading for Standard Graph of Sulphur

Sr. No.	Working standard sulphur solution in ml	ppm	O.D.
1	0	0	0
2	1	1	10
3	2	2	22
4	3	3	31
5	4	4	42
6	5	5	52
7	6	6	64
8	7	7	86
9	8	8	101
10	10	10	124
	Total ppm	46	Total: 532

Calculation:-

1 Reading = Total ppm of Sulphar/Total reading

1 Reading = 46/532
=0.09

Sulphar ppm or mg/kg

Sulphar ppm or mg/kg = sample reading X graph Factor X 50 X 25 /20 X 10

Sample Reading X 0.084871 X 50 X 25/200

Sulphar ppm = Sample Reading X 0.530443 or mg/kg

Process:

10 g air dried soil sample was taken in 150 ml conical flask. 50 ml 0.15% calcium chloride extracting solution was added and shaken on mechanical shaker for 30 min. Filtered it on whatman filter No. 42. 20 ml filtrate was taken in 25 ml volumetric flask. 2 ml glacial acetic acid, 1 g crystal of barium chloride and 1 ml gum acacia solution were added. Make up the volume to 25 ml, then first set zero optical density using blank solution (as above method without taking soil sample).Measured optical densities (O.D) of above prepared sample by using blue filter.

(9) Micronutrients (Cu, Fe, Mn, Zn) analysis by AAS

Preparation of D.T.P.A extracting solution

1.967 g D.T.P.A. and 13.3 ml triethanol amine were taken in 500 ml flask. 400 ml distilled water was added. 1.47 g calcium chloride dihydrate was taken in 1ltr flask and dissolved in 400 ml distilled water. To this solution, previously prepared D.T.P.A. & T.E.A. solution was added and pH was adjusted to 7.3 by using add 1M HCl. Make up 1 ltr with distilled water.

Analysis method for micronutrients (Cu, Fe, Mn, Zn)

Weighted 20 g dried soil sample in a plastic bottle, then added 40 ml of D.P.T.A. solution. Shake on mechanical shaker for 2 hrs. Filtered it on whatman filter No. 40 in funnel cum test tube. Prepared standard curve for element by using different working ppm solution as per standard method of analysis and condition suggested by Elico brochure and then run the sample and note the ppm of elements. Obtained ppm reading multiped with factor 2.0.

Result and Discussion

Soil sampling

Soil sampling was done during the dry season. Soil sampling was done at five randomly located points within each farm. The soils were sampled at two depths, 0 to 15 cm, 15 to 35 cm, using mini-soil pits dug at each sampling point. The soil samples were air dried in the laboratory and sieved through a 2 mm sieve for different types of laboratory analyses.

The Results of soil samples & its LMH data shown in table no: 7(A), 7(B), 8(A), 8(B), 9(A), 9(B), 10(A), 10(B), 11(A), and 11(B).

Table No-5: Critical Limits of Nutrients:-

Sr. No.	Parameters	Unit	Critical Limits		
			Low	Medium	High
1	pH	------	<6.5	6.5-8.2	>8.2
2	Electric Conductance	------	<1	1-3	>3
3	Organic carbon	%	<0.51	0.51-0.75	>0.75
4	Phosphorous	Kg/Hectare	<26	26-60	>60
5	Potash	Kg/Hectare	<151	151-300	>300
6	Zinc	ppm	<0.5	0.5-1.0	>1.0
7	Ferrous	ppm	<5	5-10	>10
8	Sulphur	ppm	<10	10-20	>20
9	Manganese	ppm	<5	5-10	>10
10	Copper	ppm	<0.2	0.2-0.4	>0.4
11	Magnesium	ppm	<1.0	1.0-2.0	>2.0
12	Calcium	ppm	<1.5	1.5-3.0	>3.0

Calculation of soil fertility Index:

$$= \frac{(\%\ \text{of Low} \times 1) + (\%\ \text{of Medium} \times 2) + (\%\ \text{of High} \times 3)}{100}$$

Table No-6: Calculation of Low, Medium, High rating of soil fertility Index:

Sr. No.	Rang	Rating
1	Less than 1.67	Low
2	1.67 to 2.33	Medium
3	Greater than 2.33	High

Table No-7(A): Analysis of soil sample

Samples site: Village : Vauva, Taluka: Santalpur, District: Patan , Gujarat, India.

Sample No.	pH	E.C.	Org. Carbon (%)	Phosphorous (Kg/ Hectare)	Pottash (Kg/ Hectare)	Zn ppm	Fe ppm	Sulphur ppm	Mn ppm	Cu ppm	Mg (Me*/100 g soil)	Ca (Me*/100 g soil)
1	8	0.23	0.51	58.03	525.94	0.68	7.36	31.3	9.8	2.44	1.95	12.55
2	7.8	0.32	0.99	39.37	473.02	1.16	6.3	19.63	11.04	2.6	2.7	11.1
3	7.5	0.33	0.49	84.97	290.42	0.7	7.62	32.89	8.88	1.68	1.75	13.55
4	7.3	0.4	0.74	76.68	377.27	1.4	7.42	32.36	1.58	2.18	2.85	14.45
5	7.7	0.31	0.8	66.32	246.28	0.64	6.62	17.5	8.44	1.6	2.3	13.4
6	7.6	0.28	0.83	45.59	278.89	1.56	7.42	31.3	13.32	3.04	1.85	12.35
7	7.9	0.4	0.87	84.97	389.79	0.8	6.86	21.22	10.92	1.54	2.75	19.35
8	7.3	0.35	0.53	62.17	224.54	0.92	9.2	18.04	9.2	2	2.7	151
9	7.7	0.49	0.45	80.82	242.66	0.46	6.54	25.99	9.16	1.44	1.85	12.15
10	7.4	0.29	0.59	68.39	206.97	0.46	9.34	13.26	6.14	1.6	2	13.6
11	7.9	0.37	0.55	70.46	341.48	0.84	7.04	28.64	11.22	2.54	1.6	11.4
12	8.1	0.22	0.57	78.75	307.99	1.08	6.62	25.46	12.56	2.06	1.55	13.15
13	7.8	0.33	0.51	47.66	396.38	0.54	9.34	18.04	6.3	1.34	1.5	9.9
14	7.4	0.23	0.76	55.95	203.68	1.72	9.14	33.42	14.36	3.54	1.55	12.35
15	7.4	0.36	0.8	8.82	200.39	0.8	5.92	36.6	10.6	1.9	0.8	13.3
16	8	0.24	0.62	53.88	208.62	0.8	6.18	18.57	10.32	1.66	2.3	13.9
17	7.3	0.24	0.49	60.1	362.89	0.78	6.68	26.52	11.46	1.66	2.35	14.05
18	7.8	0.24	0.99	62.17	208.62	0.36	6.92	25.46	7.26	1.34	1.45	8.65
19	7.7	0.39	0.64	76.68	193.8	2.28	6.54	23.87	5.64	1.16	1.25	8.45
20	7.8	0.52	0.32	58.03	272.85	2.34	8.5	19.1	12.18	1.12	2.45	10.35

***=Miliequivalent**

Table No-7(B): Soil Fertility Index & Soil Test Rating

Samples site: Village : Vauva, Taluka: Santalpur, District: Patan , Gujarat, India.

Sample No.	pH	E.C.	Org. Carbon (%)	Phosphorous (Kg/ Hectare)	Pottash (Kg/ Hectare)	Zn ppm	Fe ppm	Sulphur ppm	Mn ppm	Cu ppm	Mg (Me*/100 g soil)	Ca (Me*/100 g soil)
L	0	20	4	1	0	3	0	0	1	0	1	0
M	20	0	9	7	12	10	20	7	9	0	11	0
H	0	0	7	12	8	7	0	13	10	20	8	20
%L	0	100	20	5	0	15	0	0	5	0	5	0
%M	100	0	45	35	60	50	100	35	45	0	55	0
%H	0	0	35	60	40	35	0	65	50	100	40	100
S.F.I.**	2.00	1.00	2.15	2.55	2.40	2.20	2.00	2.65	2.45	3.00	2.35	3.00
LMH** of SFI	M	L	M	H	H	M	M	H	H	H	H	H

*= Soil Fertility Index, **= Low, Medium, and High Soil Fertility Index

CONCLUSION: It is concluded from above analysis that E.C. are in low amount. The other parameters are sufficient. pH is in medium limit, so it can be neutralized by using acidic fertilizer.

Table No-8(A): Analysis of soil sample

Samples site: Village : Ganjisar, Taluka: Santalpur, District: Patan , Gujarat, India.

Sample No.	pH	E.C.	Org. Carbon (%)	Phosphorous (Kg/ Hectare)	Pottash (Kg/ Hectare)	Zn ppm	Fe ppm	Sulphur ppm	Mn ppm	Cu ppm	Mg (Me*/100 g soil)	Ca (Me*/100 g soil)
1	8.48	0.46	0.53	51.81	589.63	0.54	13.31	35.01	10.02	2.22	0.85	15.15
2	8.3	1.14	0.74	60.1	629.15	0.54	6.9	32.36	14.24	1.66	6.3	19.9
3	8.36	0.87	0.64	72.53	618.72	0.8	78.5	40.4	13.88	1.84	6.5	20
4	8.26	3.6	0.52	76.68	195.44	0.38	3.46	34.48	10.82	1.34	0.2	11.2
5	8.3	2.2	0.64	53.88	557.24	0.38	5.88	42.44	7.48	1.7	0.6	12
6	8.12	1	0.28	66.32	398.9	0.56	4.42	41.37	15.76	1.5	1.8	15.1
7	8.26	1	0.58	58.03	507.33	0.54	5.32	38.72	16.28	1.88	1.25	18.25
8	8.19	1	0.57	68.39	588.98	0.6	3.18	38.72	13.04	1.22	8.65	11.75
9	8.31	1	0.47	55.95	427.01	0.42	3.56	40.31	11.92	1.2	0.45	12.95
10	8.45	2.2	0.48	82.89	618.43	0.4	3.08	42.44	9.48	1.06	0.75	10.45
11	8.37	0.4	0.6	64.24	418.98	0.4	4.24	41.9	13.38	1.54	16.6	8.3
12	8.49	2.6	0.52	78.75	487.25	0.38	3.68	35.01	12.32	1.22	13.5	10
13	8.45	1.7	0.7	62.17	512.68	1.32	4.84	37.13	15.46	1.56	14.8	7.4
14	8.54	2.6	0.57	70.76	298.51	0.5	2.92	32.89	9.88	1.18	13.4	9.3
15	8.62	1.1	0.54	74.6	464.49	0.7	5.94	36.07	12.24	1.72	15.6	7.6
16	8.37	3.4	0.47	66.32	465.83	0.46	3.4	33.42	12.06	1.3	16.4	8.05
17	8.6	0.61	0.57	62.17	556.14	0.32	9.46	32.89	8.86	1.68	12.8	8.7
18	8.59	0.88	0.8	70.46	578.65	0.38	6.96	31.83	9.62	1.88	13.4	10.25
19	8.23	0.5	0.56	74.6	488.59	0.58	3.9	35.54	19.24	1.44	14	9.5
20	8.5	1.27	0.55	72.53	585.78	0.62	6.64	33.42	14.9	1.64	16.7	9.35

***=Miliequivalent**

Table No-8(B): Soil Fertility Index & Soil Test Rating

Samples site: Village : Ganjisar, Taluka: Santalpur, District: Patan , Gujarat, India.

Sample No.	pH	E.C.	Org. Carbon (%)	Phosphorous (Kg/ Hectare)	Pottash (Kg/ Hectare)	Zn ppm	Fe ppm	Sulphur ppm	Mn ppm	Cu ppm	Mg (Me*/ 100 g soil)	Ca (Me*/ 100 g soil)
L	0	6	4	0	0	9	11	0	0	0	5	0
M	2	12	15	4	2	10	7	0	5	0	2	0
H	18	2	1	16	18	1	2	20	15	20	13	20
%L	0	30	20	0	0	45	55	0	0	0	25	0
%M	10	60	75	20	10	50	35	0	25	0	10	0
%H	90	10	5	80	90	5	10	100	75	100	65	100
S.F.I.*	2.90	1.80	1.85	2.80	2.90	1.60	1.55	3.00	2.75	3.00	2.40	3.00
LMH** of SFI	H	M	M	H	H	L	L	H	H	H	H	H

*= Soil Fertility Index, **= Low, Medium, and High Soil Fertility Index

CONCLUSION: It is concluded from above analysis that Fe and Zn are in low amount. Ferrous ammonium sulphate & Zinc Sulphate should be added for better plant growth & productivity. The other parameters are sufficient. pH is in high limit, so it can be neutralized by using acidic fertilizer.

Table No-9(A): Analysis of soil sample

Samples site: Village : Jakhotra, Taluka: Santalpur, District: Patan , Gujarat, India.

Sample No.	pH	E.C.	Org. Carbon (%)	Phosphorous (Kg/ Hectare)	Pottash (Kg/ Hectare)	Zn ppm	Fe ppm	Sulphur ppm	Mn ppm	Cu ppm	Mg (Me*/100 g soil)	Ca (Me*/100 g soil)
1	8.15	1.18	1.09	47.66	481.47	0.48	7.46	24.4	20	1.24	4.3	19.5
2	8.17	1.12	1.14	70.46	707.66	0.5	8.22	15.38	22.1	1.32	2.6	19.3
3	8.24	1.08	1.05	55.95	626.96	0.54	7.58	33.95	20.68	1.28	1.9	19.6
4	8.3	1.14	0.53	55.95	715.9	0.5	4.88	15.38	9.12	0.88	1.65	18.05
5	8.15	1.16	1.04	68.39	651.66	0.54	8.22	19.63	20.16	1.28	2.3	16.1
6	8.22	1.22	0.83	51.81	454.57	0.42	5.4	36.6	14.28	0.88	2.1	18.3
7	8.22	0.73	1.13	64.24	631.35	0.6	7.9	19.63	20.58	1.32	0.55	3.45
8	8.28	0.36	0.55	55.95	272.85	0.24	4.94	37.66	7.36	0.64	6.3	15.1
9	8.09	0.93	0.57	47.66	199.84	0.24	4.62	35.01	8.74	0.54	2.3	19.3
10	8.12	0.39	0.83	51.81	236.07	0.36	4.68	13.26	10.38	0.78	1.3	17.1
11	8.19	0.42	0.65	60.1	482.57	0.32	6.16	36.07	10.1	1.06	2.1	14.2
12	8.21	0.31	0.8	64.24	413.4	0.32	5.58	37.66	9.8	1.1	2.35	13.05
13	8.16	0.44	0.73	68.39	329.4	0.32	5.2	16.97	8.66	0.64	1.8	11.3
14	8.15	0.48	0.7	66.32	250.89	0.3	4.44	26.52	7.7	0.6	2.05	14.05
15	7.25	1.76	1.29	62.17	603.9	0.82	8.48	16.44	19.82	1.08	2	16.3
16	7.52	0.58	1.2	62.17	340.38	0.5	6.42	33.95	15.86	0.94	1.55	13.75
17	7.6	0.54	1.29	47.66	611.59	0.5	7.58	37.66	19.48	0.94	2.95	11.15
18	7.37	1.48	1.22	51.81	603.9	0.52	8.68	38.19	20.7	1.18	2.5	10.1
19	7.44	0.83	0.81	60.1	300.3	0.28	5.52	33.42	8.66	0.62	1.2	15.9
20	7.5	0.91	1.2	51.81	535.28	0.56	6.88	27.05	20.52	0.96	2.25	9.65

***=Miliequivalent**

Table No-9(B): Soil Fertility Index & Soil Test Rating

Samples site: Village : Jakhotra, Taluka: Santalpur, District: Patan , Gujarat, India.

Sample No.	pH	E.C.	Org. Carbon (%)	Phosphorous (Kg/ Hectare)	Pottash (Kg/ Hectare)	Zn ppm	Fe ppm	Sulphur ppm	Mn ppm	Cu ppm	Mg (Me*/ 100 g soil)	Ca (Me*/ 100 g soil)
L	0	12	0	0	0	10	5	0	0	0	1	0
M	14	8	6	10	4	10	15	7	7	0	7	0
H	6	0	14	10	16	0	0	13	13	20	12	20
%L	0	60	0	0	0	50	25	0	0	0	5	0
%M	70	40	30	50	20	50	75	35	35	0	35	0
%H	30	0	70	50	80	0	0	65	65	100	60	100
S.F.I.*	2.30	1.40	2.70	2.50	2.80	1.50	1.75	2.65	2.65	3.00	2.55	3.00
LMH** of SFI	M	L	H	H	H	L	M	H	H	H	H	H

*= Soil Fertility Index, **= Low, Medium, and High Soil Fertility Index

CONCLUSION: It is concluded from above analysis that E.C. and Zn are in low amount. Zinc Sulphate should be added for better plant growth & productivity. The other parameters are sufficient. pH is in medium limit, so it can be neutralized by using acidic fertilizer.

Table No-10(A): Analysis of soil sample

Samples site: Village : Piparala, Taluka: Santalpur, District: Patan , Gujarat, India.

Sample No.	pH	E.C.	Org. Carbon (%)	Phosphorous (Kg/ Hectare)	Pottash (Kg/ Hectare)	Zn ppm	Fe ppm	Sulphur ppm	Mn ppm	Cu ppm	Mg (Me*/100 g soil)	Ca (Me*/100 g soil)
2	8.38	0.32	0.2	72.53	497.42	0.44	10.58	10.61	11.12	1.44	3.1	9.2
3	8	0.28	0.24	55.95	369.19	0.48	11.34	14.85	12.54	1.7	1.65	8.95
4	7.95	0.36	0.26	66.32	456.33	0.48	10.96	22.28	11.8	1.62	1	9.9
5	8.38	0.32	0.2	72.53	497.42	0.44	10.58	10.61	11.12	1.44	3.1	9.2
6	8.17	0.41	0.21	58.03	543.61	0.48	10.86	19.1	13.34	1.58	3.05	8.35
7	8.12	0.29	0.53	51.81	617.9	0.44	11.34	27.58	12.06	1.48	1.25	12.1
8	8.08	0.31	0.22	60.1	552.84	0.4	16.52	21.75	13.24	1.26	2	10.1
9	7.85	0.35	0.32	80.82	583.63	0.36	10.86	25.46	12.88	1.34	2.15	14.2
10	8.17	0.25	0.63	53.88	564.49	0.52	13.66	18.04	22.02	1.38	3.2	11.1
11	8.08	0.27	0.27	62.17	617.5	0.5	11.44	27.58	12.52	1.72	3.6	7.1
12	7.94	0.21	0.32	55.95	372.53	0.5	12.22	21.22	12.2	1.52	1.4	5.4
13	7.98	1.08	0.34	72.53	638.49	0.92	12.82	14.32	16.82	1.82	2	10
14	7.92	0.41	0.25	80.82	613.78	0.48	12	20.16	13.12	1.74	3.4	5.6
15	7.87	0.31	0.51	53.88	524.84	0.34	9.54	9.02	11.98	1.24	3.95	4.95
16	8.17	0.36	0.53	68.39	650.02	0.52	11.8	13.26	16.52	1.86	3.7	5.3
17	8.09	0.23	0.32	58.03	520.45	0.54	13.12	27.58	14.58	2.1	4.1	4.5
18	8.04	0.24	0.27	78.75	527.07	0.54	12.32	15.91	12.68	1.74	3.45	4.75
19	7.93	0.21	0.3	70.46	639.58	1.26	13.9	6.37	14.98	1.9	4.3	5.6
20	8.01	0.25	0.32	51.81	461.55	0.24	9.98	18.57	12.44	0.9	3.7	5.1

***=Miliequivalent**

Table No-10(B): Soil Fertility Index & Soil Test Rating

Samples site: Village : Piparala, Taluka: Santalpur, District: Patan , Gujarat, India.

Sample No.	pH	E.C.	Org. Carbon (%)	Phosphorous (Kg/ Hectare)	Pottash (Kg/ Hectare)	Zn ppm	Fe ppm	Sulphur ppm	Mn ppm	Cu ppm	Mg (Me*/100 g soil)	Ca (Me*/100 g soil)
L	0	19	16	0	0	11	0	2	0	0	0	0
M	18	1	4	8	0	8	2	10	0	0	7	0
H	2	0	0	12	20	1	18	8	20	20	13	20
%L	0	95	80	0	0	55	0	10	0	0	0	0
%M	90	5	20	40	0	40	10	50	0	0	35	0
%H	10	0	0	60	100	5	90	40	100	100	65	100
S.F.I.*	2.10	1.05	1.20	2.60	3.00	1.5	2.9	2.3	3.0	3.0	2.65	3.00
LMH** of SFI	M	L	L	H	H	L	H	M	H	H	H	H

*= Soil Fertility Index, **= Low, Medium, and High Soil Fertility Index

CONCLUSION: It is concluded from above analysis that E.C. & Org. Carbon and Zn are in low amount. Farm yard manure & Zinc Sulphate should be added for better plant growth & productivity. The other parameters are sufficient. pH is in medium limit, so it can be neutralized by using acidic fertilizer.

Table No-11(A): Analysis of soil sample

Samples site: Village : Hamirpura, Taluka: Santalpur, District: Patan , Gujarat, India.

Sample No.	pH	E.C.	Org. Carbon (%)	Phosphorous (Kg/ Hectare)	Pottash (Kg/ Hectare)	Zn ppm	Fe ppm	Sulphur Ppm	Mn ppm	Cu ppm	Mg (Me*/100 g soil)	Ca (Me*/100 g soil)
1	7.84	0.73	0.17	45.59	452.93	0.6	5.08	27.05	19.24	1.76	2.15	9.55
2	8.09	0.47	0.25	49.74	553.39	0.4	5.52	26.52	19.36	1.52	1.9	10.4
3	7.97	1.1	0.27	53.88	676.92	0.46	4.82	38.72	15.2	1.04	2.55	10.55
4	8.14	0.37	0.14	68.39	531.43	4.4	5.38	36.07	14.88	0.78	1.4	7.9
5	8.08	0.54	0.41	62.17	676.37	0.6	3.22	35.54	18.44	0.92	1.2	13.9
6	8.04	0.78	0.39	78.75	666.49	0.6	5.02	30.24	20.74	1.1	1.65	11.05
7	7.95	0.99	0.43	74.6	561.63	0.94	5.14	16.44	16.52	0.96	1.2	11.9
8	8.88	0.44	0.14	49.74	581.94	0.4	5.08	19.63	16.26	0.92	0.6	8.9
9	8.21	0.37	0.15	58.03	517.71	0.34	4.7	31.83	13.74	0.78	0.55	8.55
10	8.04	0.86	0.41	70.46	631.35	0.4	5.2	27.05	14.02	0.92	1.1	6.4
11	8.17	0.38	0.24	62.17	312.93	0.34	4.52	28.11	13.9	0.74	0.95	6.35
12	8.22	0.29	0.39	47.66	471.04	0.84	6.08	28.64	15.82	2.02	1.15	7.65
13	7.99	0.69	0.37	55.95	392.54	0.28	5.64	16.44	20.78	1.4	1.55	8.55
14	8.7	0.77	0.41	74.6	517.71	0.96	5.52	13.26	18.18	1.26	1.35	9.45
15	8.12	0.52	0.2	82.89	575.35	0.56	6.76	23.37	7.54	1.32	0.1	8.8
16	7.9	0.68	0.34	66.32	318.42	0.48	5.32	24.4	17.48	1.42	1.45	10.25
17	8.14	0.5	0.39	82.89	553.39	0.54	4.96	16.44	13.28	1.68	0.75	8.55
18	7.98	0.85	0.42	82.89	383.2	0.4	5.14	31.83	17.36	1.32	0.65	8.45
19	8.16	0.35	0.35	62.17	460.06	0.18	4.28	16.44	7.88	0.78	1.05	7.55
20	7.84	0.23	0.27	72.53	345.87	0.44	5.02	20.69	12.3	1.04	1.15	6.15

***=Miliequivalent**

Table No-11(B): Soil Fertility Index & Soil Test Rating

Samples site: Village : Hamirpura, Taluka: Santalpur, District: Patan , Gujarat, India.

Sample No.	pH	E.C.	Org. Carbon (%)	Phosphorous (Kg/ Hectare)	Pottash (Kg/ Hectare)	Zn ppm	Fe ppm	Sulphur ppm	Mn ppm	Cu ppm	Mg (Me*/ 100 g soil)	Ca (Me*/ 100 g soil)
L	0	19	20	0	0	11	6	0	0	0	6	0
M	16	1	0	7	0	8	14	6	2	0	12	0
H	4	0	0	13	20	1	0	14	18	20	2	20
%L	0	95	100	0	0	55	30	0	0	0	30	0
%M	80	5	0	35	0	40	70	30	10	0	60	0
%H	20	0	0	65	100	5	0	70	90	100	10	100
S.F.I.*	2.20	1.05	1.00	2.65	3.00	1.50	1.70	2.70	2.90	3.00	1.80	3.00
LMH** of SFI	M	L	L	H	H	L	M	H	H	H	M	H

*= Soil Fertility Index, **= Low, Medium, and High Soil Fertility Index

CONCLUSION: It is concluded from above analysis that E.C. & Org. Carbon and Zn are in low amount. Farm yard manure & Zinc Sulphate should be added for better plant growth & productivity. The other parameters are sufficient. pH is in medium limit, so it can be neutralized by using acidic fertilizer.

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