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# Study of the most significant properties of soil of Visnagar Taluka, Mehsana District

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## Abstract:

We have studied agricultural soil of Visnagar Taluka of Mehsana District, Gujarat. The samples location areas were approximately 5-10 Kilometre from each other. All soil samples were analyzed for pH, electrical conductivity, calcium, magnesium, sulphur, organic carbon, potash, phosphorous, copper, iron, manganese and zinc. Low, medium & high range of above parameter also calculated from analysis data. Five representative locations were selected for the study and 20 samples from each location and direction of area were collected. The main aim of this paper is to study soil fertility status of soil samples. 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:** Agricultural, Soil, Electrical conductivity, Fertility status.

## Introduction:

Soil testing is a three-step process: the collection of a representative sample from each field or section, proper analysis of that sample to determine the levels of available nutrients, and use of the results to determine optimum fertilizer rates. Keeping records is an integral part of the soil-testing process; they will help determine if soil test levels are increasing, decreasing or being maintained over time.

Soil is a very importance complex that can be defined as a mixture of minerals and organic materials, which are capable of supporting plant life [1, 2]. Only small amounts of nutrients are available for plants [3]. Soil contains some type's elements essential for plant growth [4]. Nutrients become available through mineral weathering and through decomposition of organic matter into inorganic mineral which are absorbed by plants in the form of ions [2, 4, 5]. Traditionally, an assessment of the nutrient status in the soil requires a separate extraction and measurement process for most elements [6]. In the last decades Ion exchange resin has been used to assess the availability of plant nutrients where anion and cation exchange resins are used in numerous ways in soil and plant analysis [7, 8]. The method simulates removing ions from soil by plant roots to prevent equilibrium of ions

between the solid and the solution phases [9, 10]. A major problem in using bead resins is the difficulty in their separation from the soil following the extraction [9, 11]. In addition to its simplicity, rapidness and accuracy compared to other existing methods, the technique was found to be highly

Further, various factor other than poor soil fertility may also be responsible for poor crop production but soil fertility status assumes a greater importance. Each fertilizer recommendation based on a soil analysis should take into account the soil test value obtained by the accurate soil analysis, the research work conducted on a crop response to fertilizer application in a particular area and the practices and level of management of the concerned farmer.

## 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) 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 | 41 |
| 3 | 1.5ml | 15ppm | 47.5 |
| 4 | 2.0ml | 20ppm | 56.5 |
| 5 | 2.5ml | 25ppm | 62.5 |
| 6 | 3.0ml | 30ppm | 72 |
| 7 | 4.0ml | 40ppm | 101 |
| | Total | 140ppm | 380.5 |

### Calculation

1 Reading = Total Solution of ppm / Total Reading
=140 / 380.5
= 0.368

1 Gram Soil = R X 0.368 X 5 Microgram K / Gram Soil (0.368 Graph Factor)
R= Flame Photometer Reading of sample

**K**
Kg/Hectare = R X 0.368 X 5 X 2.24 (2.24 = Factor in **K** Hectare)

**$K_2O$**
Kg/Hectare = R X 0.368 X 5 X 2.24 X 1.20 (1.20 = Factor in **$K_2O$** Hectare)
= R X 4.945

**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.

**(2) 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-2: 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 | 30 |
| 3 | 2 | 0.010 g | 65 |
| 4 | 3 | 0.015 g | 92 |
| 5 | 4 | 0.020 g | 124 |
| 6 | 5 | 0.025 g | 152 |
| 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.

**(3) 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-3: Reading for Standard Graph of Sulphur**

| Sr. No. | Working standard sulphur solution in ml | ppm | O.D. |
|---|---|---|---|
| 1 | 0 | 0 | 0 |
| 2 | 1 | 1 | 11 |
| 3 | 2 | 2 | 21 |
| 4 | 3 | 3 | 29 |
| 5 | 4 | 4 | 43 |
| 6 | 5 | 5 | 53 |
| 7 | 6 | 6 | 64 |
| 8 | 7 | 7 | 81 |
| 9 | 8 | 8 | 104 |
| 10 | 10 | 10 | 126 |
| | Total ppm | 46 | Total: 532 |

**Calculation:-**

**1 Reading** = Total ppm of Sulphar/Total reading

1 Reading = 46/532
=0.0864

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 0.0864 X 50 X 25/200

**Sulphar ppm = Sample Reading X 0.54041 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.

**(4) 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.

**(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-4: 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 | 39 |
| 4 | 3 ml = 6 ppm | 5 ml | 5 ml | 1 ml | 58 |
| 5 | 4 ml = 8 ppm | 5 ml | 5 ml | 1 ml | 79 |
| 6 | 5 ml = 10 ppm | 5 ml | 5 ml | 1 ml | 105 |
| 7 | 10 ml = 20 ppm | 5 ml | 5 ml | 1 ml | 195 |
| | Total = 50 ppm | | | | 498 |

**Calculation**

1 Reading

= Total Solution of ppm / Total Reading
=50 / 498
= 0.100
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) 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

**(7) 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.

**(8) 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.

**(9) 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.

**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. | Range | 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 : Bajipur, Taluka: Visnagar, District: Mehsana, Gujarat, India.

| Sample No. | pH | EC | 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 | 8.71 | 0.23 | 0.76 | 84.97 | 299.85 | 0.66 | 3.08 | 12.73 | 13.72 | 0.94 | 3.6 | 12 |
| 2 | 8.97 | 0.18 | 0.36 | 60.10 | 218.19 | 0.28 | 2.92 | 7.96 | 9.94 | 0.86 | 3.15 | 12.35 |
| 3 | 8.73 | 0.15 | 0.82 | 91.18 | 212.84 | 0.36 | 3.24 | 5.83 | 7.2 | 0.54 | 4.25 | 12.45 |
| 4 | 8.85 | 0.14 | 0.39 | 66.32 | 206.14 | 0.38 | 3.18 | 12.20 | 14.9 | 0.7 | 3.1 | 11.8 |
| 5 | 8.92 | 0.14 | 0.61 | 74.60 | 283.78 | 0.36 | 3.24 | 10.61 | 14.66 | 0.68 | 4.65 | 9.55 |
| 6 | 9 | 0.15 | 0.46 | 91.18 | 269.06 | 0.42 | 2.92 | 6.37 | 11.88 | 0.54 | 2.45 | 10.05 |
| 7 | 8.6 | 0.14 | 0.62 | 70.46 | 286.46 | 0.36 | 3.18 | 8.49 | 15.56 | 0.66 | 1.5 | 11.6 |
| 8 | 8.65 | 0.18 | 0.43 | 43.52 | 239.61 | 0.32 | 3.4 | 11.67 | 8.54 | 0.64 | 2.5 | 8.7 |
| 9 | 8.64 | 0.19 | 0.70 | 87.04 | 238.27 | 0.32 | 3.4 | 6.90 | 9.6 | 0.6 | 4.25 | 8.75 |
| 10 | 8.89 | 0.19 | 0.41 | 89.11 | 243.63 | 0.36 | 3.24 | 8.49 | 8.44 | 0.52 | 4.2 | 9.9 |
| 11 | 8.98 | 0.14 | 0.83 | 91.18 | 279.77 | 0.32 | 3.18 | 6.37 | 6.9 | 0.6 | 4.8 | 8.9 |
| 12 | 8.52 | 0.33 | 0.37 | 95.33 | 200.79 | 0.32 | 3.02 | 13.26 | 11.88 | 0.58 | 4.3 | 10.1 |
| 13 | 8.56 | 0.30 | 0.80 | 78.75 | 204.81 | 0.36 | 2.98 | 12.20 | 10.04 | 0.5 | 3.9 | 9.9 |
| 14 | 8.56 | 0.34 | 0.45 | 87.04 | 271.74 | 1.14 | 3.08 | 10.61 | 11.5 | 0.58 | 1.95 | 9.25 |
| 15 | 8.53 | 0.29 | 0.62 | 70.46 | 401.58 | 0.64 | 3.46 | 11.14 | 12.58 | 0.64 | 1.3 | 8.5 |
| 16 | 8.73 | 0.12 | 0.36 | 93.26 | 190.08 | 0.14 | 2.82 | 6.90 | 8.08 | 0.66 | 1.1 | 9.7 |
| 17 | 8.48 | 0.18 | 0.54 | 87.04 | 301.19 | 0.12 | 3.08 | 8.49 | 8.86 | 0.5 | 1.65 | 9.75 |
| 18 | 8.53 | 0.18 | 0.36 | 78.75 | 281.11 | 0.12 | 3.02 | 7.43 | 9.68 | 0.6 | 2.5 | 10.4 |
| 19 | 8.65 | 0.15 | 0.41 | 84.97 | 323.94 | 0.12 | 3.08 | 9.55 | 10.64 | 0.62 | 2.45 | 10.85 |
| 20 | 8.75 | 0.15 | 0.47 | 93.26 | 207.48 | 0.16 | 3.08 | 11.67 | 13.32 | 0.58 | 2.45 | 11.05 |

***=Miliequivalent**

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

**Samples site:** Village : Bajipur, Taluka: Visnagar, District: Mehsana, Gujarat, India.

| Sample No. | pH | EC | 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 | 11 | 0 | 0 | 17 | 20 | 11 | 0 | 0 | 0 | 0 |
| M | 0 | 0 | 5 | 1 | 17 | 2 | 0 | 9 | 9 | 0 | 5 | 0 |
| H | 20 | 0 | 4 | 19 | 3 | 1 | 0 | 0 | 11 | 20 | 15 | 20 |
| %L | 0 | 100 | 55 | 0 | 0 | 85 | 100 | 55 | 0 | 0 | 0 | 0 |
| %M | 0 | 0 | 25 | 5 | 85 | 10 | 0 | 45 | 45 | 0 | 25 | 0 |
| %H | 100 | 0 | 20 | 95 | 15 | 5 | 0 | 0 | 55 | 100 | 75 | 100 |
| S.F.I.* | 3.00 | 1.00 | 1.65 | 2.95 | 2.15 | 1.20 | 1.00 | 1.45 | 2.55 | 3.00 | 2.75 | 3.00 |
| LMH** of SFI | H | L | L | H | M | L | L | L | H | H | H | H |

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

**CONCLUSION:-** Above results indicate that E.C.& Org.Carbon & Zn & Fe & Sulphur are in low amount, farm yard manure & Zinc Sulphate & Ferrous Sulphate & Potassium Sulphate should be added for better plant growth & productivity. The other parameters are sufficient in limit. pH is in high in limit so it can be neutralized by using acidic fertilizer.

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

**Samples site:** Village : Bhalak, Taluka: Visnagar, District: Mehsana, Gujarat, India.

| Sample No.. | pH | EC | 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 | 8.31 | 0.42 | 1.10 | 47.66 | 338.67 | 0.44 | 4.34 | 51.45 | 8.72 | 0.7 | 3.4 | 10.4 |
| 2 | 8.30 | 0.43 | 0.72 | 26.94 | 198.11 | 0.4 | 4.14 | 25.46 | 9.5 | 0.72 | 2.55 | 8.65 |
| 3 | 8.30 | 0.60 | 0.72 | 84.97 | 354.73 | 0.38 | 4.02 | 49.33 | 7.58 | 0.72 | 3.6 | 7.7 |
| 4 | 7.91 | 1.23 | 0.83 | 82.89 | 322.60 | 0.72 | 3.94 | 144.28 | 8.26 | 0.82 | 2.9 | 8.3 |
| 5 | 8.39 | 0.33 | 0.72 | 31.09 | 261.03 | 0.34 | 3.82 | 49.86 | 13.66 | 0.58 | 3.1 | 11.8 |
| 6 | 8.48 | 0.43 | 0.89 | 64.24 | 271.74 | 0.4 | 4.66 | 29.17 | 9.24 | 0.82 | 1.85 | 8.65 |
| 7 | 8.66 | 0.25 | 0.77 | 70.46 | 198.11 | 0.3 | 4.26 | 30.77 | 9.94 | 0.54 | 4.1 | 7.6 |
| 8 | 8.40 | 0.40 | 0.66 | 45.59 | 302.52 | 0.28 | 4.6 | 28.11 | 8.86 | 0.88 | 2.35 | 6.45 |
| 9 | 8.56 | 0.21 | 0.97 | 29.01 | 262.37 | 0.32 | 4.86 | 20.16 | 11.1 | 0.76 | 5.2 | 9 |
| 10 | 7.98 | 1.09 | 1.24 | 62.17 | 257.01 | 0.38 | 4.26 | 45.62 | 18.04 | 0.82 | 3.35 | 7.45 |
| 11 | 8.81 | 0.20 | 0.74 | 26.94 | 207.48 | 0.34 | 4.4 | 17.50 | 7.6 | 0.94 | 4.25 | 8.05 |
| 12 | 8.62 | 0.20 | 0.66 | 68.39 | 206.14 | 0.36 | 4.26 | 17.50 | 9.9 | 0.58 | 3.7 | 7.8 |
| 13 | 8.46 | 0.40 | 0.79 | 64.24 | 191.42 | 0.24 | 4.34 | 28.11 | 7.14 | 0.6 | 3.15 | 8.65 |
| 14 | 8.41 | 0.43 | 0.83 | 29.01 | 273.07 | 0.32 | 4.26 | 26.52 | 7.86 | 0.84 | 3.55 | 8.55 |
| 15 | 8.38 | 0.40 | 0.73 | 22.80 | 389.53 | 0.26 | 4.2 | 30.77 | 6.98 | 0.66 | 1.7 | 7.7 |
| 16 | 8.59 | 0.22 | 0.66 | 31.09 | 231.58 | 0.34 | 4.14 | 22.28 | 10.64 | 0.6 | 5.25 | 8.95 |
| 17 | 8.21 | 0.30 | 0.83 | 24.87 | 344.02 | 0.28 | 4.2 | 20.69 | 7.54 | 0.72 | 2.35 | 7.95 |
| 18 | 8.44 | 0.33 | 0.79 | 26.94 | 299.85 | 0.3 | 4.34 | 33.42 | 8.38 | 0.76 | 5.3 | 9.6 |
| 19 | 8.57 | 0.37 | 0.58 | 68.39 | 368.12 | 0.34 | 4.46 | 44.03 | 11.84 | 0.82 | 2.6 | 8.8 |
| 20 | 7.95 | 0.29 | 0.79 | 29.01 | 297.17 | 0.3 | 4.34 | 48.80 | 7.6 | 0.68 | 2.6 | 13.3 |

***=Miliequivalent**

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

**Samples site:** Village : Bhalak, Taluka: Visnagar, District: Mehsana, Gujarat, India.

| Sample No.. | pH | EC | 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 | 18 | 0 | 2 | 0 | 19 | 20 | 0 | 0 | 0 | 0 | 0 |
| M | 3 | 2 | 9 | 10 | 13 | 1 | 0 | 2 | 15 | 0 | 2 | 0 |
| H | 17 | 0 | 11 | 8 | 7 | 0 | 0 | 18 | 5 | 20 | 18 | 20 |
| %L | 0 | 90 | 0 | 10 | 0 | 95 | 100 | 0 | 0 | 0 | 0 | 0 |
| %M | 15 | 10 | 45 | 50 | 65 | 5 | 0 | 10 | 75 | 0 | 10 | 0 |
| %H | 85 | 0 | 55 | 40 | 35 | 0 | 0 | 90 | 25 | 100 | 90 | 100 |
| S.F.I.* | 2.85 | 1.10 | 2.55 | 2.30 | 2.35 | 1.05 | 1.00 | 2.90 | 2.25 | 3.00 | 2.90 | 3.00 |
| LMH** of SFI | H | L | H | M | H | L | L | H | M | H | H | H |

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

**CONCLUSION:-** Above results indicate that E.C., Zn & Fe are in Low Amount, Zinc Sulphate & Ferrous Ammonium Sulphate should be added for better plant growth & productivity. The other parameters are sufficient in limit. pH is in high in limit so it can be neutralized by using acidic fertilizer.

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

**Samples site:** Village :Khadalpur, Taluka: Visnagar, District: Mehsana, Gujarat, India.

| Sample No. | pH | EC | 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 | 7.91 | 0.19 | 1.17 | 43.52 | 345.36 | 0.66 | 7.08 | 23.87 | 20.12 | 0.94 | 1.9 | 6.3 |
| 2 | 7.92 | 0.14 | 1.21 | 55.95 | 286.46 | 0.8 | 8.12 | 30.24 | 17.56 | 0.94 | 2.2 | 6.5 |
| 3 | 7.93 | 0.16 | 1.16 | 47.66 | 298.51 | 0.68 | 8.56 | 39.25 | 18.16 | 1 | 1.95 | 7.05 |
| 4 | 7.69 | 0.18 | 1.21 | 49.74 | 505.99 | 0.56 | 12.56 | 35.01 | 17.66 | 1.72 | 2 | 6.6 |
| 5 | 8.90 | 0.19 | 0.97 | 39.37 | 452.45 | 0.3 | 4.22 | 34.48 | 14.48 | 1 | 3.75 | 7.95 |
| 6 | 8.40 | 0.52 | 0.72 | 35.23 | 298.51 | 0.32 | 6.16 | 61.53 | 16.46 | 0.96 | 1.45 | 5.85 |
| 7 | 8.20 | 0.54 | 0.62 | 45.59 | 239.61 | 0.42 | 6.58 | 60.47 | 18.34 | 1.14 | 3.05 | 7.65 |
| 8 | 8.30 | 0.59 | 1.04 | 37.30 | 372.13 | 0.6 | 8.12 | 43.50 | 23.16 | 1.2 | 3.2 | 8.4 |
| 9 | 8.10 | 0.20 | 0.94 | 55.95 | 333.31 | 0.4 | 6.08 | 57.82 | 19.5 | 1.14 | 1.55 | 11.65 |
| 10 | 8.50 | 0.48 | 0.89 | 47.66 | 314.57 | 0.26 | 5.32 | 46.68 | 18.6 | 1.04 | 3.2 | 7.7 |
| 11 | 8.20 | 0.19 | 0.79 | 22.80 | 424.34 | 0.2 | 4.22 | 23.87 | 19.28 | 1.08 | 2.3 | 6.8 |
| 12 | 7.60 | 0.16 | 0.80 | 26.94 | 319.93 | 0.28 | 12.9 | 33.95 | 33.2 | 1.66 | 2.2 | 7.7 |
| 13 | 7.80 | 0.18 | 1.09 | 37.30 | 493.94 | 0.28 | 11.44 | 36.07 | 16.84 | 1.54 | 1.25 | 5.45 |
| 14 | 7.70 | 0.16 | 0.65 | 43.52 | 352.05 | 0.2 | 9.08 | 38.19 | 20.06 | 1.22 | 1.35 | 4.75 |
| 15 | 7.80 | 0.32 | 1.19 | 53.88 | 310.56 | 0.7 | 6.5 | 27.58 | 12.2 | 1.34 | 1.8 | 5.5 |
| 16 | 7.42 | 0.25 | 1.24 | 64.24 | 472.53 | 0.42 | 11.2 | 44.56 | 35.74 | 1.16 | 1.2 | 5.4 |
| 17 | 7.79 | 0.15 | 0.64 | 87.04 | 376.15 | 0.1 | 7.82 | 22.28 | 19.54 | 1 | 1.75 | 6.35 |
| 18 | 8.35 | 0.37 | 0.69 | 78.75 | 269.06 | 0.12 | 7.02 | 33.42 | 15.7 | 1.1 | 4.1 | 7.5 |
| 19 | 8.47 | 0.44 | 0.73 | 72.53 | 298.51 | 0.02 | 7.38 | 21.22 | 13.98 | 0.94 | 4.1 | 7.5 |
| 20 | 8.80 | 0.46 | 0.76 | 66.32 | 358.74 | 1.98 | 6.02 | 30.77 | 19.5 | 1.04 | 3.5 | 8.6 |

***=Miliequivalent**

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

**Samples site:** Village :Khadalpur, Taluka: Visnagar, District: Mehsana, Gujarat, India.

| Sample No. | pH | EC | 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 | 0 | 1 | 0 | 13 | 2 | 0 | 0 | 0 | 0 | 0 |
| M | 13 | 0 | 6 | 14 | 6 | 6 | 14 | 0 | 0 | 0 | 10 | 0 |
| H | 7 | 0 | 14 | 5 | 14 | 1 | 4 | 20 | 20 | 20 | 10 | 20 |
| %L | 0 | 100 | 0 | 5 | 0 | 65 | 10 | 0 | 0 | 0 | 0 | 0 |
| %M | 65 | 0 | 30 | 70 | 30 | 30 | 70 | 0 | 0 | 0 | 50 | 0 |
| %H | 35 | 0 | 70 | 25 | 70 | 5 | 20 | 100 | 100 | 100 | 50 | 100 |
| S.F.I.* | 2.35 | 1.00 | 2.70 | 2.20 | 2.70 | 1.40 | 2.10 | 3.00 | 3.00 | 3.00 | 2.50 | 3.00 |
| LMH** of SFI | H | L | H | M | H | L | M | H | H | H | H | H |

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

**CONCLUSION:-** Above results indicate that E.C. & Zn are in low amount, Zinc Sulphate should be added for better plant growth & productivity. The other parameters are sufficient in limit. pH is in high in limit so it can be neutralized by using acidic fertilizer.

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

**Samples site:** Village :Valam, Taluka: Visnagar, District: Mehsana, Gujarat, India.

| Sample No. | pH | EC | 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 | 8.36 | 0.30 | 0.89 | 24.87 | 318.59 | 0.36 | 4.72 | 47.74 | 13.32 | 0.78 | 3.3 | 9.6 |
| 2 | 8.30 | 0.33 | 0.87 | 26.94 | 266.38 | 0.34 | 3.94 | 31.83 | 10.8 | 0.58 | 2.3 | 8.2 |
| 3 | 8.13 | 0.41 | 0.72 | 43.52 | 314.57 | 1.18 | 4.16 | 31.83 | 14.38 | 0.92 | 4 | 9.5 |
| 4 | 8.22 | 0.32 | 0.88 | 66.32 | 325.28 | 0.84 | 3.86 | 42.97 | 12.88 | 0.82 | 3 | 8.5 |
| 5 | 8.80 | 0.31 | 0.89 | 82.89 | 369.45 | 0.92 | 3.94 | 63.65 | 14.68 | 0.82 | 3.65 | 9.85 |
| 6 | 8.56 | 0.13 | 0.79 | 22.80 | 331.97 | 0.44 | 4.24 | 16.97 | 13.12 | 0.54 | 2.4 | 6.7 |
| 7 | 8.36 | 0.27 | 0.69 | 29.01 | 262.37 | 0.48 | 4.72 | 16.44 | 15.06 | 0.78 | 2.9 | 7.6 |
| 8 | 8.41 | 0.23 | 0.87 | 24.87 | 297.17 | 0.32 | 4.46 | 17.50 | 12.18 | 0.74 | 2.05 | 7.85 |
| 9 | 8.32 | 0.23 | 0.88 | 29.01 | 346.70 | 0.24 | 4.5 | 45.62 | 16.36 | 0.88 | 2.85 | 7.85 |
| 10 | 8.10 | 0.25 | 0.76 | 26.94 | 338.67 | 1.24 | 4.54 | 29.70 | 15.1 | 1.08 | 3.25 | 7.95 |
| 11 | 8.19 | 0.76 | 0.89 | 82.89 | 417.64 | 0.3 | 4.2 | 74.79 | 17.72 | 0.54 | 3.35 | 7.15 |
| 12 | 8.40 | 0.32 | 0.72 | 24.87 | 236.93 | 0.28 | 4.24 | 38.72 | 8.24 | 0.66 | 3.05 | 6.45 |
| 13 | 8.43 | 0.25 | 0.76 | 29.01 | 271.74 | 0.32 | 4.46 | 28.11 | 11.1 | 0.7 | 2.15 | 7.65 |
| 14 | 8.37 | 0.34 | 0.79 | 68.39 | 218.19 | 0.36 | 4.54 | 22.81 | 13.4 | 0.84 | 2.55 | 6.95 |
| 15 | 8.28 | 0.30 | 0.89 | 64.24 | 396.23 | 0.4 | 4.5 | 27.58 | 18.24 | 0.96 | 2.7 | 8.7 |
| 16 | 8.45 | 0.16 | 0.88 | 66.32 | 313.23 | 0.3 | 4.98 | 22.81 | 19.02 | 0.7 | 3.2 | 5.2 |
| 17 | 8.28 | 0.33 | 0.82 | 29.01 | 313.23 | 0.36 | 4.12 | 27.05 | 14.96 | 0.78 | 3.4 | 6.4 |
| 18 | 8.20 | 0.37 | 0.77 | 24.87 | 344.02 | 0.8 | 3.74 | 34.48 | 12.84 | 0.84 | 3.2 | 8.1 |
| 19 | 8.00 | 0.39 | 0.91 | 45.59 | 301.19 | 1.2 | 4.2 | 62.59 | 15.18 | 1.02 | 3.05 | 8.15 |
| 20 | 8.24 | 0.27 | 0.88 | 29.01 | 319.93 | 0.64 | 4.16 | 17.50 | 13.36 | 0.78 | 2.7 | 6.1 |

***=Miliequivalent**

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

**Samples site:** Village :Valam, Taluka: Visnagar, District: Mehsana, Gujarat, India.

| Sample No. | pH | EC | 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 | 0 | 5 | 0 | 13 | 20 | 0 | 0 | 0 | 0 | 0 |
| M | 5 | 0 | 3 | 9 | 6 | 4 | 0 | 4 | 1 | 0 | 0 | 0 |
| H | 15 | 0 | 17 | 6 | 14 | 3 | 0 | 16 | 19 | 20 | 20 | 20 |
| %L | 0 | 100 | 0 | 25 | 0 | 65 | 100 | 0 | 0 | 0 | 0 | 0 |
| %M | 25 | 0 | 15 | 45 | 30 | 20 | 0 | 20 | 5 | 0 | 0 | 0 |
| %H | 75 | 0 | 85 | 30 | 70 | 15 | 0 | 80 | 95 | 100 | 100 | 100 |
| S.F.I.* | 2.75 | 1.00 | 2.85 | 2.05 | 2.70 | 1.50 | 1.00 | 2.80 | 2.95 | 3.00 | 3.00 | 3.00 |
| LMH** of SFI | H | L | H | M | H | L | L | H | H | H | H | H |

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

**CONCLUSION:-** Above results indicate that E.C. & Zn & Fe are in low amount, Zinc Sulphate & Ferrous Sulphate should be added for better plant growth & productivity. The other parameters are sufficient in limit. pH is in high in limit so it can be neutralized by using acidic fertilizer.

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

**Samples site:** Village :Hasanpur, Taluka: Visnagar, District: Mehsana, Gujarat, India.

| Sample No. | pH | EC | 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 | 8.11 | 0.34 | 0.72 | 22.80 | 207.48 | 0.3 | 4.9 | 20.16 | 13.24 | 0.7 | 1.15 | 7.05 |
| 2 | 8.15 | 0.53 | 0.57 | 43.52 | 186.07 | 0.14 | 5.46 | 31.30 | 12.14 | 1.14 | 2.65 | 6.85 |
| 3 | 8.15 | 0.34 | 0.56 | 49.74 | 155.28 | 0.18 | 4.18 | 23.34 | 12.74 | 0.86 | 2.05 | 6.25 |
| 4 | 7.26 | 0.44 | 1.14 | 29.01 | 417.64 | 0.46 | 6.52 | 57.29 | 27.74 | 1.28 | 3.65 | 6.75 |
| 5 | 7.55 | 0.63 | 0.82 | 22.80 | 310.56 | 0.28 | 5.14 | 81.16 | 20.74 | 1.28 | 2.75 | 8.25 |
| 6 | 7.52 | 0.23 | 0.66 | 64.24 | 277.09 | 0.2 | 5.42 | 15.91 | 14.16 | 1 | 7.00 | 5.5 |
| 7 | 7.43 | 1.05 | 0.76 | 43.52 | 202.13 | 0.46 | 4.68 | 77.44 | 26.44 | 1.06 | 3.15 | 8.25 |
| 8 | 7.66 | 0.32 | 0.70 | 49.74 | 298.51 | 0.64 | 4.86 | 29.17 | 17.9 | 1.18 | 2.25 | 7.25 |
| 9 | 7.82 | 0.69 | 0.79 | 43.52 | 323.94 | 0.44 | 5.84 | 53.04 | 20.46 | 1.3 | 5.70 | 7.6 |
| 10 | 7.81 | 0.27 | 0.77 | 51.81 | 325.28 | 0.16 | 3.96 | 19.63 | 15.3 | 1 | 1.40 | 10.1 |
| 11 | 7.70 | 0.21 | 0.60 | 47.66 | 326.62 | 0.32 | 6.98 | 31.83 | 30.64 | 1.56 | 6.45 | 6.85 |
| 12 | 7.45 | 0.29 | 0.87 | 43.52 | 254.33 | 0.48 | 6.24 | 18.04 | 19.72 | 1.8 | 3.00 | 9.5 |
| 13 | 7.47 | 0.21 | 0.53 | 64.24 | 228.90 | 0.26 | 5.74 | 20.16 | 12.98 | 0.98 | 4.35 | 8.25 |
| 14 | 7.51 | 0.25 | 0.60 | 41.45 | 250.32 | 0.1 | 4.54 | 32.36 | 22.6 | 0.88 | 5.80 | 7.1 |
| 15 | 7.42 | 0.39 | 1.06 | 26.94 | 295.83 | 0.38 | 5.46 | 21.75 | 16.24 | 1.62 | 2.00 | 6.5 |
| 16 | 8.50 | 0.36 | 0.53 | 43.52 | 187.40 | 0.26 | 3.66 | 15.91 | 9.7 | 0.68 | 3.95 | 6.25 |
| 17 | 7.56 | 0.25 | 1.03 | 93.26 | 211.50 | 0.58 | 4.62 | 30.77 | 22.92 | 1.42 | 2.85 | 7.25 |
| 18 | 7.23 | 0.16 | 0.66 | 29.01 | 251.66 | 0.1 | 6.24 | 20.16 | 26.98 | 1.24 | 3.60 | 6.8 |
| 19 | 7.50 | 0.16 | 0.57 | 26.94 | 243.63 | 0.12 | 7.76 | 31.30 | 27.7 | 1.2 | 3.45 | 7.75 |
| 20 | 8.31 | 0.37 | 0.53 | 29.01 | 172.68 | 0.08 | 4.18 | 14.85 | 11.14 | 0.68 | 2.50 | 5.3 |

***=Miliequivalent**

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

**Samples site:** Village :Hasanpur, Taluka: Visnagar, District: Mehsana, Gujarat, India.

| Sample No. | pH | EC | 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 | 0 | 0 | 0 | 20 | 0 | 0 | 0 | 0 | 0 | 0 |
| M | 18 | 1 | 12 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 3 | 0 |
| H | 2 | 0 | 8 | 20 | 20 | 0 | 20 | 20 | 19 | 20 | 17 | 20 |
| %L | 0 | 95 | 0 | 0 | 0 | 100 | 0 | 0 | 0 | 0 | 0 | 0 |
| %M | 90 | 5 | 60 | 0 | 0 | 0 | 0 | 0 | 5 | 0 | 15 | 0 |
| %H | 10 | 0 | 40 | 100 | 100 | 0 | 100 | 100 | 95 | 100 | 85 | 100 |
| S.F.I.* | 2.10 | 1.05 | 2.40 | 3.00 | 3.00 | 1.00 | 3.00 | 3.00 | 2.95 | 3.00 | 2.85 | 3.00 |
| LMH** of SFI | M | L | H | H | H | L | H | H | H | H | H | H |

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

**CONCLUSION:-** Above results indicate that E.C. & Zn are in low amount, Zinc Sulphate should be added for better plant growth & productivity. The other parameters are sufficient in limit. pH is in medium in limit so it can be neutralized by using acidic fertilizer.

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