# ANALYSIS OF MAJOR NUTRIENTS IN SOIL

DONE AT

**THE FERTILIZERS AND CHEMICAL TRAVANCORE LIMITED (FACT)**

**UDYOGAMANDAL**

SUBMITTED TO

**MAHATMA GANDHI UNIVERSITY**

In partial fulfillment of degree

**BACHELOR OF SCIENCE IN CHEMISTRY MODEL II**

SUBMITTED BY

**SIDDIQUE HASSAN, Reg No. 170021040577**

**DINO DAVID, Reg No. 170021040564**

**ARUNDAS .H, Reg No. 170021040516**

**MANU MURUKAN, Reg No. 170021040572**

Under the guidance of

**MR.PRADEEP.P**

[Asst.Manager (QA), Soil Testing Lab, FACT, Udyogamandal]



**DEPARTMENT OF CHEMISTRY**

**St.PAUL’S COLLEGE**

**KALAMASSERY**

**2017-2020**

**CERTIFICATE**

This is hereby to certify that the original and genuine investigation work has been carried out to investigate about the subject matter and the relative data collection and investigation has been completed solely, sincerely and satisfactorily by DINO DAVID, regarding his project titled " ANALYSIS OF MAJOR PRODUCTS IN SOIL” in partial fulfillment for the Bachelor of Science in Industrial Chemistry from St. Paul’s College, kalamassery in the academic year 2017-20.

Examiner Head of the Department Project Guide

Date:

Place:

**DECLARATION**

We hereby declare that dissertation entitled ‘**The analysis of major nutrients in soil’** submitted to the University of Mahatma Gandhi. In partially fulfillment of the required for the award of degree of Bachelor of Science in Chemistry in a word of original project done by us under the supervision and guidance of **Mr.PRADEEP.P** (Asst.Manager(QA)-STL,FACT, during the period 2019-2020.

SIDDIQUE HASSAN 170021040577

DINO DAVID 170021040546

ARUNDAS. H 170021040516

MANU MURUKAN 170021040572

Name of the candidate Register Number Signature

**Head of department Associate professor, Internal guide**

**Mr. TEXIN JOSEPH Mrs. TRESA SUNITHA GEORGE**

**External Examiner**

**Name:**

**Signature:**

# ACKNOWLEDGEMENT

# We wish to express our deep sense of gratitude to the FACT Marketing division for giving us an opportunity to this project work in their soil testing Lab, Agronomy department.

We are very thankful and deeply indebted **to Mr.PRADEEP.P**[Asst.Manager (QA), Lab-in-charge, STL.], FACT, Marketing division who stood as a backbone of our project. We are grateful to **Mr. K. Radhakrishna Pillai** (Engineer (QA), STL) for his valuable support throughout the project. We extend our gratitude to all staff members of the soil department for their support and their valuable suggestions during our project.

We express our sincere gratitude to **Mr.Texin Joseph,(**Head of department of Chemistry St. Paul’s college kalamassery), and our internal guide**Dr. Tresa Sunitha George, (**Associate professor,St. Paul’s college, kalamassery),who gave us full support and guidance during our project work .Weavail this opportunity to express our gratitude to all other teachers and non-teaching staffs of the Department of Chemistry.

Also,our sincere thanks to our parents and our friends. Above all,we thank Almighty God enabling us to complete this project work successfully.

THE FERTILIZERS AND CHEMICAL TRAVANCORE LIMTED,(FACT)

KALAMSSERY

# CONTENTS

**Chapter 1 INTRODUCTION**6

1.1 ABOUT FACT 6

1.2 INTRODUCTION TO STL 7

**Chapter 2**

2.1AIM 8

2.2 SCOPE 9

**Chapter 3 LITERATURE SURVEY**10

**Chapter 4 INSTRUMENTAL METHODS**18

4.1 ELECTROCONDUCTIVITY METER 18

4.2 FLAME PHOTOMETER 19

4.3 AAS 21

**Chapter 5 MATERIALS AND METHODS** 25

**Chapter 6 RESULTS AND DISCUSSION**33

**Chapter 7CONCLUSIONS**39

**Chapter 8BIBLIOGRAPHIES**40

1. INTRODUCTION
   1. **About FACT**

The Fertilizers And Chemicals Travancore Limited was established at Udyogamandal, on of the river Periyar in 1944.It is the first large scale fertilizer factory in the entire country. FACT has since grown, expanded and branched in a fantastic manner. So that today it is not only merely one of the biggest fertilizer enterprises in the country, but also in legend of the modern times and a triumph of the public sector.

FACT today has three manufacturing divisions, two at Udyogamandal and other at Ambalamedu close to Kochi Refineries Ltd. The important products of FACT are FACTAMPHOS 20:20, ammonia, ammonium sulphate, ammonium phosphate, sulphuric acid etc.In addition to these petrochemical products like caprolactum, cyclohexanol, cyclonone etc are being produced.

FACT has the widest-range of fertilizers and it makes available to the farmers spread over a wide area, covering the entire south states, fertilizers like FACTAMPHOS 20:20 DAP and host of NPK mixtures to suit all crops and all soils.

**1.2. About soil testing lab**

FACT is rendering soil test services to the farmers of southern states viz. Kerala, Tamil Nadu, Karnataka and Andhra Pradesh at free of cost . Soils are generally grouped into low, medium and high depending upon the sufficiency level of the primary nutrients in the soil. During the year 2016-17, Soil Testing Laboratory under FACT marketing division set an all time record of analyzing 11029 soil samples from five South Indian states. This includes 2522 samples from Kerala, 2944 samples from Tamil Nadu, 2447 samples from Karnataka, 1384 samples from Telungana and 1732 samples from Andhra Pradesh.

According to the Ministry of Agriculture, Govt. of India’s initiative, FACT Soil Testing Laboratory has implemented SAP module for generating soil health cards online. The samples are collected from farmers by FACT’s marketing network. The sample details are registered on SAP and the samples are sent to the Soil Testing Lab where the macronutrients N, P & K along with four micronutrients Zinc, Manganese, Iron and Copper are analysed. The results are entered on the SAP system which in turn generates the Soil Health Cards for a specified crop according to the results. These Health Cards are generated in English and four south Indian local languages and distributed to the farmers through corresponding Krishi Vigyan Kendras (KVK) of FACT. The card suggests the application of right quantity of fertilizer at the right time. There is also a provision to transmit The Soil Health Card electronically to the farmer into his email, if provided.

The soil Health Card prevents the excess usage of fertilizer which saves the money of the farmer and also helps to reduce soil and water pollution to a great extent. As the commitment of FACT to the farmers, soil analysis and the Soil Health Card distribution are done absolutely free of cost. Any farmer can directly submit their samples, which are collected according to the standard procedure, to the Soil Testing Laboratory and can get them analysed free of cost.

During 2018-19, Soil Testing Lab created another milestone in its history by developing Phosphate Rich Organic Manure (PROM), in house.

**AIM**

The aim of the project is to get acquaintance with the analytical methods used for the determination and estimation of nutrients**, p H** and electrical conductance of south Indian soil samples.

**SCOPE**

In spite of surplus food production in our country, India’s biggest population is facing malnutrition and citizens are becoming dependant onmeditations instead of nutritive food.

“Health of citizen is prime importance in the overall development of the nation,which is only achievable with nutritive food.The nutritive and healthy food can only be oozed out from nutrient rich healthy soil. So the soil health is the crucial need of the hour.”

Soil is the main source of nutrients for crops.Essential plant nutrients such as N,P, and K are called **macronutrients.**Apart from nutrients,soil pH estimation is also critical in the assessment of soil health.Generally plants prefer soils that are close to either side of neutrality.It is necessary to assess the capacity of soil to supply nutrients in order to supply the remaining amounts of needed plant nutrients (total crop requirement-soil supply).Thus, Soil Testing Laboratories are considered **nerve centers for nutrient management and cropproduction system.**

The aim of the project is to get acquaintance with the analytical methods used for the determination and estimation of nutrients**, p H** and electrical conductance of south Indian soil samples.

# LITERATURE SURVEY

Precisely speaking, soil testing measures the quantity of available nutrients in the soil.For a long time soil testing was considered as a tool to diagnose the causes for poor plant growth.The first attempt to assess the fertility status based on total quantities of plant nutrients in the soil was not successful.Further attempts for this were directed to extract the quantity of nutrient which would be proportional to that which a plant could obtain from the soil during its entire period of growth.Presently various extractants and procedures are used to characterize the available portion of plants nutrient in the soil.Different extractants remove different quantities of plant nutrients from the soil.The results from each analytical procedure must be calibrated with the response of plants to the application of that nutrient to the field.The must permit the interpretations that can be used in making fertilizers recommendations.

The present procedures in soil testing are aimed to assess the primary nutrient elements and lime requirements of the soil.Of late; attentionhas also been given to the estimation of micro nutrient status.

**NITROGEN**

In the soil,Nitrogen occurs mostly in the organic form.Its conversion to inorganic nitrogen, which is the readily available form, is made through the activity of micro organics.

Both biological and chemical methods are available to measure the nitrogen supply power of the soil.Chemical methods have the advantage over the other method in that,their rapid convenient and precise.However the chemical methods have an inherent drawback in that none of these methods can simulate the activities of soil micro organisms to release selectively that fraction of soil nitrogen which is made available for plant growth through the activity of these organisms.

Two methods viz. The wet oxidation method for estimating the organic carbon and the alkaline permanganate method of the organic matter are commonly adopted in soil testing laboratories to indicate the nitrogen status.The former method is, however, very popular than the latter .It must be recognized that this tests for nitrogen do not present the precise interpretation commonly expected from appropriate tests for phosphorous and potassium.

**PHOSPHOROUS**

Available phosphorous is one of the key determinations in soil testing. Various extractants like water,strongly ionized to weakly ionized acids, alkaline solutions,buffered solutions etc.are being tried to estimate the available phosphorous content in the soil. Attempts are being made to choose an extractant that will indicate the available portion ofsoil phosphorous which will have a higher correlation with the crop response to phosphate application.The present finding is that the extractant which will indicate the sorbed and/or acid soluble form of phosphorous status in the soil.

Olsen’s sodium bicarbonate and Bray’s No.1 methods are widely adopted in the soil testing laboratories.Among the numerous other methods which are now under investigation ,the modified Olsen’s method (hunter, 1970) shows promise in that this method does not show difficulties that are usually encountered with regard to the other two methods.

On some plantation soil, Bray No.1 method has shown great promise.Serious difficulty is usually observed in choosing a good method which can be used on low land rice soils.

**POTASSIUM**

The quantity of the exchangeable portion of soil potassium is usually considered to indicate the potassium supplying capacity of the soil.This is usually extracted with ammonium acetate .Salts of other cations are also used instead of ammonium for this purpose. However the stand point of laboratory operation, use of the same extractant for both P and K has obvious advantages and this possibility is to be explored.

Micronutrient deficiencies,specially of zinc, copper, manganese,boron and molybdenum have been revealed in Indian conditions.Even though they are required only in very small amounts,these elements can reduce the yield if the deficiency is not corrected .It is always advisable to have the soils analyzed for the micronutrients contents if the deficiency is suspected.

The tediousness of the methods of analysis and the interpretation of the analytical results are the main difficulties generally observed in our laboratories .However with the introduction of more sophisticated equipments like Atomic Absorption Spectrophotometer and getting more research findings on the use of these elements under Indian conditions,way is being opened in our laboratories for undertaking the analytical for these elements.

**SOIL ACIDITY AND LIME REQUIREMENTS**

A normal soil pH is between 6 and 8.5.Most crops row well within that range.If a soil falls outside this normal range of pH, it is an indication that an amendment is necessary to improve the productivity.Soils having a pH 6require the application of lime to raise pH to a normal level.

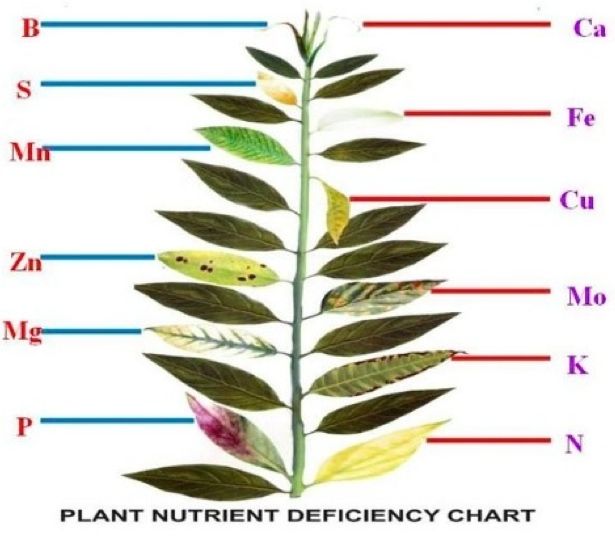
Soil acidity, as measured by pH to a normal level.

Soil acidity,as measured by pH, was used in the past predicting the quantity of lime to correct the soil.Now it is recognized that pH alone does not provide an adequate measure,and the buffered solution such as those proposed by Shoemaker et al(1961)or Woodruff(1948)are widely used in soil testing laboratories.Recently the international Soil Fertility evaluation Project of North Carolina State University has brought out another approach to estimate the actual lime requirement .In this method,the quantity of lime applied is adjusted just to overcome the detrimental effect of exchangeable aluminum and to provide the Ca and Mg need for growth.This overcomes the detrimental effects of over liming.

**SALINITY AND ALKALINITY**

Under arid conditions, thesalts formed during the weathering of rocks get accumulated in the soil itself. During the hot weather,these salts come up to the surface soil due to capillary movement of water.In cultivated soils,conditions like inadequate drainage and use of water containing high concentration of salts etc. cause the accumulation of salts in the surface soil.These salts can inhibit plant growth.The soil, then, is said to saline.

The salt concentration is usually determined in the laboratory by measuring the electrical conductivity .The plants differ very much in their tolerance to salts.Howeverif the electrical conductivity of the saturation extracts of the soil exceeds 4.0mmhos/cm,it is considered that the presence sodium in exchange complex has exceeded the limit.Such situation can be detrimental to the proper plant growth,where this is observed,a gypsum requirement test such as that proposed by *Shoonover(1952)*will help to estimate the amount of gypsum or equivalent amount of other soil amendments which may be required to bring the exchangeable sodium down to an acceptable level.When gypsum is applied to the application must always be followed by a leeching operation to remove the replaced sodium.Plant nutrients fall into 2 categories: Macronutrients and Macronutrients are those elements that are needed in relatively large amounts. They include nitrogen,potassium,sulphur,calcium, magnesium and phosphorus.Micronutrients are those elements that plants need in small amounts (sometimes trace amounts), like iron,boron,manganese,zinc,copper,chlorine and molybdenum.Both macro- and micro nutrients are naturally obtained by the roots from the soil.



[**Figure no. 1**]

**MACRONUTRIENTS**

|  |  |  |  |
| --- | --- | --- | --- |
| NUTRIENTS | DEFICIENCY  SYMPTOMS | COMMENTS | FERTILIZER  SOURCE |
| Nitrogen  (N) | General  yellowing of  older leaves  (bottom of  Plant).The  rest of the  plant is often  light green | Most plants  absorb  nitrogen in  the form of  ammonium or  nitrate.  These forms  readily  dissolve in  water and  leach away. | Anything  with the  words  “ammonium”,  “nitrate”,  or “urea”. Also  manures |
| Phosphorous  (P) | Leaf tips look  burnt,  followed by  older leaves  turning a dark  green  or reddish  purple | Plants absorb  phosphorous  In the  form of  phosphate.  This form  dissolves only  slightly in  water,  but pH  strongly  affects uptake | Anything  With the  Words  “phosphate”  or “bone.”  Also  Greensand. |

|  |  |  |  |
| --- | --- | --- | --- |
| Potassium  (K) | Older leaves  may wilt, look  scorched.Inter-veinal chlorosis  begins at the  base,  scorching  inward from  leaf margins | Plants absorb potassium as an ion,which can be readily  leached from  soil.Desert  soils and  water  generally  have plenty of  potassium,so  deficiency  problems are rare. | Anything  with the  words  “potassium”  or “potash.” |

**INSTRUMENTAL METHODS**

**ELECTRIC CONDUCTIVITY METER**

Electrolytic conductivity is a measure of the ability of a solution to carry electric current. Solutions of electrolytes conduct an electric current by a migration of ions under the influence of an electric field. Like a metallic conductor, they obey Ohm’s law. Exceptions to this law occur only under abnormal conditions, for example very high voltage or high frequency currents. Thus for an applied electromotive force **E**, maintained constant but at a value that exceeds the decomposition voltage of electrolyte, the current **I** flowing between the electrodes immersed in the electrolyte will vary inversely with the resistance of the electrolyte **R**. The reciprocal of the resistance **1/R** is called **Conductance**, and is expressed in reciprocal of Siemens/mhos/reciprocal of ohms.

The electrical conductance of a solution is a summation of contribution from all the ions present. It depends upon the number of ions per unit volume of the solution and upon the velocities with on which these ions move under the influence of the applied electromotive force. The conductivity of a solution is quite temperature dependent. An increase in temperature invariably results in an increase of ionic conductance and for most ions these amounts to 2% per degree. For precise work conductance cell must be immersed in a constant temperature bath. It is customary to select 250C for measurements. For relative measurements, as in titration, the conductance cell needs only to attain thermal equilibrium within surroundings before proceeding with conductance measurements.

**FLAMEPHOTOMETRY**

If a solution containing metallic salt (or some other metallic compound) is aspirated into a flame, a vapour which contains atoms of the metal may be formed. Some of these gaseous metal atoms may be raised to an energy level which is sufficiently high to permit the emission of radiation characteristic of that metal, e.g. the characteristic yellow colour imparted to flame by compounds of sodium.

When a solution containing a suitable compound of the metal to be investigated is aspirated into a flame, the following events occur in rapid succession:

1. Evaporation of solvent leaving a solid residue,
2. Vaporization of the solid with dissociation into its constituent atoms, which initially, will be the ground states, and
3. Some atoms may be excited by the thermal energy of the flame to higher levels, and attain a condition in which they radiate energy.

The resulting emission spectrum thus consists of lines originating from excited atoms or ions.

**ELEMENTARY THEORY**

Consider the simplified energy level diagram shown in the following figure, where E0 represents the ground state in which the electrons of a given atom are at their lowest energy level and E1, E2, E3, represent higher or excited energy levels.

Transition between two quantized energy levels, say from E0 to E1, corresponds to the absorption of radiant energy, and amount of energy absorbed (E) is determined by Bohr’s equation

**∆E= E1−E0=hʋ=hc/ʎ**

Where

c=velocity of light

h=plank’s constant

ʋ=frequency

ʎ=wavelength of the radiation absorbed

Clearly, the transition from E1 to E0 corresponds to the emission of radiation of frequency ʋ.

Since an atom of a given element gives rise to a definite, characteristic line spectrum, it follows that there are different elements. The consequent emission spectra involve not only transition from excited state to ground state, e.g. E3 to E0, E2 to E0, but also the transitions such as E3  to E0, E3 to E1, etc. Thus it follows that the emission spectrum of given element may be quit complex.



[**Figure no. 2**]

**FLAME PHOTOMETER**

**ATOMIC ABSORPTION SPECTROSCOPY**

Atomic absorption spectroscopy (AAS) is a spectral analytical procedure for the quantitative determination of chemical elements using the absorption of optical radiation (light) by free atoms in the gaseous state. In analytical chemistry the technique is used for the determining the concentration of a particular element(the analyte) in a simpleto be analyzed.AAS can be used to determine over 70 different elements in solution or directly in solid samples used in pharmacology, biophysics and toxicology research.

Principle:

If light of just the right wavelength impinges on a free ground state atom, the atom may absorb the light as it enters an excited state in a process known as atomic absorption. This process is illustrated on the right. Atomic absorption measures the amount of light at the resonant wavelength which is absorbed as it passes through a cloud of atoms. As the number of atoms in the light path increases, the amount of light absorbed increases in a predictable way. By measuring the amount of light absorbed, a quantitative determination of the amount of analyte element present can be made.The use of special light sources and careful selection of wavelength allow the specific quantitative determination of individual elements in the presence of others.

The atom cloud required for atomic absorption measurements is produced by supplying enough thermal energy to the sample to dissociate the chemical compounds into free atoms.Aspirating a solution of the sample into a flame aligned in the light beam serves this purpose.Under the proper flame conditions,most of the atoms will remain in the ground state form and are capable of absorbing light at the analytical wavelength from a source lamp. The ease and speed at which precise and accurate determinations can be made with this technique have made atomic absorption one of the most popular methods for the determination of metals.

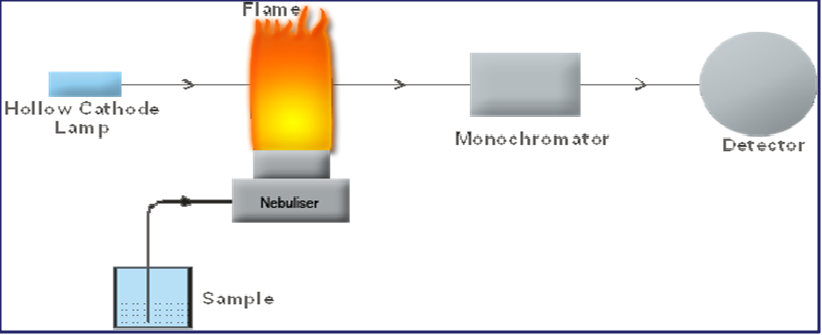
**Instrumentation**

In order to analyze a sample for its atomic constituents, it has to be atomized. The atomizers most commonly used now a day are flames and electro thermal (graphite tube) atomizers. The atoms should then be irradiated by optical radiation, and the radiation source could be an element-specific line radiation source or a continuum radiation source. The radiation then passes through a monochromator in order to separate the element specific radiation from any other radiation emitted by the radiation source, which is finally measured by a detector

Atomizers: the atomizers most commonly used now a day are (spectroscopic) flames and electro thermal (graphite tube) atomizers. Other atomizers source such as glow discharge atomization, hydride atomization, or cold vapor atomization must beused for special purposes.

Flame atomizers: the oldest and most commonly used atomizers in AAS are flames; principally the air – acetylene flame with a temperature of about 23000C and the nitrous oxide system(N2O)-acetylene flame with a temperature about 27000C.The latter flame in addition,offers a more reducing environment, being ideally suited for analytes with high affinity to oxygen.

Liquid or dissolve samples are typically used with flame atomizers.The sample solution is aspirated by a pneumatic analytical nebulizer,transformed into an aerosol,which is introduced into a spray chamber, where it is mixed with flame gases and conditioned in a way that only the finest aerosol droplets(<10µm)enter the flame.This conditioning process is responsible that only about 5% of the aspirated sample solution reaches the flame,but it also guarantees a relatively high freedom from interference.On top of the camper is a burner head that produces a flame that is laterally long(usually 5-10) only a few mm deep. The radiation beam passes through the flame at its longest axis,and the flame gas flow-ratesmay be adjusted to produce the highest concentration of free atoms.The burner height may be adjusted, so that the radiation beam passesthrough the zone of highest atom colourdensity in the flame, resulting in the highest sensitivity.



[**Figure no. 3**]

**Schematic diagram of an Atomic Absorption Spectrophotometer**

The process in a flame includes the following stages:

* Desolvation (drying)-the solvent is evaporated and the dry simple nano-particles remain;
* Vaporization (transfer to the gaseous phase)-the solid particles are converted into gaseous molecules;
* Atomization –the molecules are dissociated into free atoms;
* Ionization –depending on the ionization potential of the analyte atoms and the energy available in a particular flame,atoms might be in part converted to gaseous ions.

Each of these stages includes the risk of interference in the case the degree of phase transfer is different for the analyte in the calibration standard and in the sample .Ionization is generally undesirable,as it reduces the number of atoms that are available for measurements ,i.e., the sensitivity.

In flame AAS a steady –state signal is generated during the time period when the sample is aspirated.The technique is typically used for determination in the mgL-1 range,and may be extended down to a few µgL-1 range,and may be extended down to a few µgL -1 for some elements.

****

[**Figure no. 4**]

**ATOMIC ABSORPPITION SPECTROSPHOTOMETER**

**MATERIALS AND METHODS**

**SAMPLE COLLECTION**

Prepare a map of area to be covered in a survey showing different sampling unit boundaries.Enter a plan of the number of the samples and manner of composite sampling on the map,designating different fields by letters (A,B,C, etc.).Traverse each area separately.Cut a slice of the plough layer at intervals of 15-20 steps or according to the area to be covered .Generally, depending on the size of the field, 10-20 spots must be taken for one composite sample.

Scrape away surface litter to obtain a uniformly thick slice ofsoil from the surface to the plough depth from each spot .Make a V-shaped cut with a spade to remove a 1-2-cm slice of soil.Collect the sample on the blade of spade and put it in a clean bucket.In this way,collect samples from all the spots marked for one sampling unit. In the caseof hard soil,takes samples with the help of an auger from the plough depth and collect them in the bucket.

Pour the soil from the bucket onto a piece of a clean paper or cloth,and mix it thoroughly,spread the soil evenly and divide it into quarters.Reject two opposite quarters and mix the rest of the soil again.Repeat the process until left with about 0.5 kg of the soil.Collect it and put in a clean cloth bag.Mark each bag clearly in order to identity the sample.

The following are the general items of analysis usually done in a soil testing laboratory.

1. Available amounts of major nutrients i.e. N,P,K.
2. Available amounts of micro nutrients i.e. Zn, Cu, Mn, etc.

III. Soil texture and pH

**1. AVAILABLE NITROGEN**

+Usually the available Nitrogen status of the soil is estimated in the laboratories throughassessing the content of organic carbon.

Carbon occurs in the soil in four forms.

1. Carbonate mineral form.
2. Highly condensed and mostly eliminatory organic carbon, E.g. Charcoal, graphite, coal etc.
3. Altered and resistant organic residues, minerals and micro organisms often treated as humus.
   1. The title altered organic residues of plants, animals and living as well as dead micro organisms, which are subjected to rather rapid decomposition in soil.

The chemically active organic matter that is related to soil fertility includes forms items 3 and 4 listed above.

The oxidizable organic matter content in the soil usually determined by the west oxidation method (chromic acid oxidation method).this method is very rapid,popular and has the advantagethatit can satisfactorily discriminate the humus from the very highly condensed forms which include graphite and charcoal in the soil.

**WET OXIDATION METHOD**

**Reagents:**

1. Potassium dichromate solution 1N –dissolve 49.04 gm of potassium dichromate (AR)in1 litre of distilled water.

2. Concentrated sulphuric acid.

**Method:**

In a 100ml conical flask, scoop out 1 gm of soil and pipette out 10 ml of potassium dichromate solution. To this,and 10ml of concentrated sulphuric acid.Swirl the flask and allow the reaction to continue for 30 minutes with intermittent mixing.Then add 10 ml of distilled water. Mix the contents very well and keep to allow a clear supernatant liquid to settle at the top.Usually,the flask is allowed to stand overnight.The colour of supernatant liquid is read out using a spectrophotometer. At 650 nm,after setting the instrument to zero,using the blank solution prepared in the same manner.

The organic matter is to be expressed in percentage by multiplying the calorimeter reading with the appropriate factor obtained from the standard curve.

**2. AVAILABLE PHOSPHOROUS**

The available phosphorous content in soils is usually determined in soil testing labs by adopting Bray No.1 method for cid soils and Olsen’s method for neutral and alkaline soils.Of late,Bray No 2 method which uses a higher concentration of acid,is also used for plantation soils where they are more acidic.

In allthese methods the phosphorous content of the extractant solution is determined by the reduction of the molybdate heteropoly complex by using stannous chloride as the reducing agent.This heteropoly complex is thought to be formed by the coordination of the molybdate ion with phosphorousas thecentral coordinating atom.The hetropoly complex,before reduction,gives a yellow hue to the solution.At high phosphorous concentration,a yellow precipitate is formed.In solutions having low concentration which are suitable for determination by reduction to form the blue colour.This yellow colour is so faint that it is not usually noticed.Before the addiction of the reductant, the solution is to bemixed well to ensure that the proper acidity is brought in to the solution and required pH is set in.

**Procedure**

Bray with slight warming.Cool and filter y no.1 Method.

This has to be adopted for soils having a pH below 6.5

**Reagents:**

Bray No.1 is extractant (0.03 normal ammonium fluoride in 0.025 normal HCL).Mix well and make up the solution ton 10 liters ,after through mixing.

Boric acid:Dissolve 50 gm of boric acid in distilled water with slight warming is necessary .The solution can be then cooled and made up to 1 liter.It is to be ensured that the final solution is clear.

Chloromolybdic acid:dissolve 15 gm ammonium molybdate in about 300 ml of distilled water with slight warming.Cool and filter if necessary. To this solution, add 350 ml of 10 N HCL or 292 ml of 12N HCL with rapid stirring.When this solution is again cooled to the room temperature,it can be diluted with distilled water to exactly to 1 liter.Mix well and store in amber glass stoppered bottle.

Stannous chloride:Dissolve 10 gm of crystalline stannous chloridein 25 ml of concentrated HCl.This is the concentrated solutionof stannous chloride and can be stored under liquid paraffin or mineral oil without getting oxidized.

**Method**

Scoop out 2.5 gm of soil sample into 100 ml conical flask.Add 25 ml of Bray No.1 extractant and shake the suspension for 5 minutes on a shaking machine with the standard speed and then filter.Pipette out 5 ml of the clear filtrate into a test tube and add 4 ml of 0.8 molar of boric acid and 2.5 ml of chloromolybdic acid solution.Mix well and add 1 ml of stannous chloride solution and immediately mix.The blue colour formed is read out in spectrophotometer, after 5 minutes and before 20 minutes at 650 nm.

1. **AVAILABLE POTASSIUM**

Available potassium status in soil is usually determined in Soil Testing Labs by measuring the exchangeable potassium. After the extraction, the potassium content in the extractant can be measured either by using a Flame Photometer or by turbid metrically using a photo electric colorimeter.

**FLAME PHOTOMETRIC METHOD**

**Reagents:**

Normal neutral ammonium acetate solution: Dissolve 82 gm of ammonium acetate in a liter of water.Test withBromothymol blue or with pH is not neutral,it has to be adjusted using either ammonium hydroxide or by acetic acid.

Alternatively, dilute 108 ml concentrated ammonium hydroxide and dilute to 115 ml of glacial acetic acid to a litre, mix the two solutions and adjust the pH to 7.

**Procedure:**

Add 25 ml of ammonium acetic extractant to 5gm of measured soil in a conical flaskand shake the soil suspension for 5 minutes.Filter and add 2 drops of butyl alcohol to the filtrate.Determine the potassium content in it using a flame photometer

Estimate the potassium contents in the filtrate from the standard curve.

**Calculation**:

1 hectare = 100m\*100m

Soil depth = 20 cm

Density of soil =1.12gm/cc

Volume =100\*100\*20/100\*1000 kg

Weight of soil =100\*100\*20/100\*1.12\*1000

=2.24\*106\*10/2

=11.2\*106

In ppm =11.2\*106/106

=11.2

Available potassium =reading \*11.2

**PROCEDURE FOR EXTRACTION BY DTPA**

Once standard curves have been prepared, proceeds for extraction by DTPA as follows:

* Put 10 gm of soil in a 100 ml narrow- mouthed polypropylene bottle.
* Add 20 ml of DTPA extracting solution
* Stopper the bottle, and shake for 2 hours in the room temperature (250C).
* Filter the contents using filter paper No.1 or No 42, and collect the filtrate in polypropylene bottles.

Prepare a blank following all steps except taking the soil sample.

The extract so obtained is used for different micronutrients.For extraction of a more accurate quantity of an element that has a higher degree of correlation with plant availability, there are elements – specific extractants.However the estimation procedure on an AAS remains unchanged.

Estimation on an AAS

The procedure is:

* Select an element - specific hollow cathode lamp and mount it on the AAS.
* Start the flame.
* Set the instrument at zero using the blank solution.
* Aspirate the standard solution of different concentration one by one and record the readings.
* Prepare the standard curve,plotting the concentration of element concerned and the corresponding absorbance on the AAS with a correlation coefficient that maybe nearly as high as1.0.
* Aspirate the soil extractant obtained for the estimationof the nutrient elements in the given soil sample and observe the readings.
* Determine the content of the element in the sol extract by observing its concentration on the standard curve against the absorbance.

**SOIL pH**

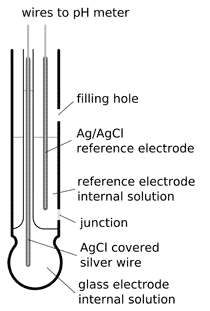
The soil pH is the negative logarithm of the active hydrogen ion (H+) concentration in the soil solution .It is the measure of soil acidity, sodicity or neutrality. It is simple but every important estimation for soils as soil pH has a considerable influence on the availability of nutrients to crops.It also affects the microbial population in the soil .Most nutrient elements are available in the pH range of 5.5-6.5.

In various chemical estimation, pH regulation is critical.The apparatus required in order to measure soil pH consist of:

* A pH meter with range of 0-14 pH;
* A pipette/dispenser
* Some beakers;
* A glass rod.

The reagents required are :

* Buffer solution of pH 4,7,9.
* Calcium Chloride solution (0.01M): dissolve 14.7g of CaCl2.2H2O in 10 liters of water to obtain 0.01 M solution.



[**Figure no. 5**]

**pH electrode - structure**

The procedures for measuring soil pH are:

1. Calibrate the pH meter , using two buffer solution ,one should be the buffer with the neutral pH with (0.7) and other should be chosen based on the range of pH in soil .Put the buffer solutions in the beakers.Insert the electrode alternately in the beakers containing the two buffer solution, and adjust the pH.The instrument indicating pH as per the buffer is ready to test the samples.
2. Place 10.0 g of soil sample into a 50 ml or 100 ml beaker,add 20 ml of CaCl2 solution (use water instead of CaCl2 solution throughout the procedure where water is used as the suspension medium).
3. Allow the soil to absorb CaCl2 solution without stirring, then stirthoroughly for 10 seconds using glass rod .
4. Stir the suspension for 30 minutes,and record the pH on the calibrated pH meter.

**ELECTRICAL CONDUCTIVITY**

Electrical conductivity is a measure of ionic transport in a solution between the anode and cathode .This means ,EC is normally considered to be the measurement of the dissolve salts in the solution .Similar to a metallic conductor ,the obey Ohm’s law.

The apparatus required in order to determine EC is consist of:

* An EC meter;
* Some beakers
* Filter paper.

Place 20 gm of soil in 250 ml beaker, add 40 ml distilled water, shake on a reciprocating shaker for one hour .Filter through NO.1filter paper. Wash the electrode,and dip it into the soil extract. Record the digital display corrected to 250C-.The EC reading is a measure of the soluble salt content in the extract, and an indication of salinity status of the soil sample.

**RESULTS AND DISCUSSION**

Sample collected from Kannur district.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| LAB  No. | AV.N  (OC %) | AV.P  Kg/ha | AV.K  Kg/ha | pH | EC  ds/m |
| 144 | 1.25 | 23 | 213 | 6.1 | 0.10 |
| 145 | 0.90 | 70 | 202 | 6 | 0.09 |
| 146 | 1.24 | 23 | 202 | 5.9 | 0.1 |
| 147 | 0.83 | 16 | 56 | 5.7 | 0.06 |
| 148 | 0.98 | 09 | 190 | 5.9 | 0.1 |
| 149 | 1.02 | 15 | 56 | 5.8 | 0.09 |
| 150 | 0.96 | 18 | 224 | 5.4 | 0.26 |
| 151 | 1.16 | 23 | 202 | 5.6 | 0.23 |
| 152 | 0.89 | 18 | 202 | 5.6 | 0.15 |
| 153 | 0.96 | 14 | 235 | 5.6 | 0.13 |

ORGANIC COMPOUND: Sample no. 144,145,146,147,148,149,150,151,152,153 has organic compound **high.**

PHOSPOROUS: Sample no. 148 is **low**.

Sample no. 144,146,147,149,150,151,152,153 is **medium.**

Sample no. 145 is **high.**

POTASSIUM: sample no. 147,149 is **low**.

Sample no. 144,145,146,148,150,151,152,153 is **medium.**

PH: sample no. 144,145,146,147,148,149,150,151,152,153 is **low.**

CONDUCTIVITY: sample no. 144,145,146,147,148,149,150,151,152,153 is **high.**

[**Figure no. 6**]

**Graph showing available nitrogen content**

[**Figure no. 7**]

**Graph showing available phosphorous content**

[**Figure no. 8**]

**Graph showing available potassium content**

[**Figure no. 9**]

**Graph showing PH level**

[**Figure no. 10**]

**Graph showing available electric conductance**

**CONCLUSION**

The aim of this project is to study the soil samples from Kannur. The final result of this study indicates that presence of essential nutrients in soil is one of the main reasons for good crop production. Good knowledge about soil health and its maintenance is critical to sustaining crop productivity. STL analyze the soil samples collected from the district Kannur and the test results with fertilizer recommendations are sent to the concerned farmers for the management of both soil health and fertility.

The analyzed soil samples show deficiency of NPK. Suitable fertilizers and other natural remedies for the enhancement of soil is suggested for good crop production. The production in agriculture depends upon soil health, soil column thickness, nutrients reservoir and its organic carbon content and cultural practices.

**BIBLIOGRAPHY**

* Guide to laboratory establishment for plant nutrient analysis by M.R Motsara, R.N Roy.
* Vogel’s test book of quantitative analytical chemistry.
* Chemistry of soil by Firman .E. Bear.
* Analytical chemistry by Springel.
* GBC SensAA Operation Manual.
* Work instructions laboratory manual, STL.
* Test book of soil chemistry by L. Bhattacharya.
* Micronutrients in agriculture by Mortvedt.
* Soil analysis hand book of reference method by J. Benton joines.