CHEMICAL EVALUATION OF PHOSPHORUS, ZINC & COPPER TO STUDY SOIL FERTILITY STATUS

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ABSTRACT

organic matter, minerals, gases, liquids& organisms are mixed with soli its supports to life. crop growth and production is depand upon the proper nutrition . nutrition is very essensial. The soil tests can help to determine the status of plant available nutrients and develop recommendations fertilizer to reach optimum crop production.It is used to Atomic Absorption Spectrometer (AAS) analyze metals at very low concentrations, typically in the parts per million (ppm) or parts per billion (ppb) ranges. A colorimeter is a device used in colorimetry. A specific solution have the absorbance of particular wavelengths of light .All living organisms are need Phosphorus (P) . Normal growth and maturity of the plant needs Phosphours. . A role of photosynthesis, cell division energy storage cell enlargement and transfer, respiration cell division, and several other processes in plants essential of phosphours. A plant must have normal production cycle is copmlited by hwelp of phosphours. Copper is water soluble and the particle size of the fertilizer is small so efficiency is improved if the fertilizer. Zinc ammonia complexes are typically found in starter fertilizers. They work well in liquid blends made from ammonium phosphate. Specific ammoniated zinc solutions can also be mixed with UAN or aqua ammonia solutions.

1. INTRODUCTION

Soil **consist** of organic matter, minerals, gases, liquids& organisms that **along** support life. Earth's body of soil **is that the** pedosphere, **that** has four **necessary** functions; **it's** a medium for plant growth; **it's a way** of water storage, **provide** and purification;
It is a modifier of Earth's atmosphere; **it's** a **surround** for organisms; all of **that**, in turn, modify the soil.
It is the material that found on the earth's surface and is made of organic and inorganic material. The typical soil consists of **concerning forty fifth** mineral, **five-hitter** organic matter, 20-30% of air. It is a blend of natural issue, minerals, gases fluids and living beings that together help to the existence of many life forms that have evolved on our planet.

1.1 Soil types

1.1.1 Sandy soil

Sandy soils are light, warm, dry and tend to be acidic and low in nutrients. Sandy soils are often known as light soils due to their high proportion of sand and little clay (clay weights more than sand).

1.1.2 Clay soil

Clay soil is heavy soil that benefit from high nutrient. Clay soils **stay** wet and cold in winter and dry come in summer. These soils **square measure product of** over **twenty five p.c** clay, and because of the spaces found between clay particles, clay soils hold a high amount of water.

1.1.3 Silt soil

Silt soils are light and moisture retentive soils with a high fertility rating. As silt soils compromise of medium sized particles, **they're** well drained and hold **wetness** well

1.1.4 Peat soil

Peat soils are high organic matter and retain large amount of moisture. And these **square** measure shaped from part rotten stuff underneath anaerobic water saturated conditions.

1.1.5 Chalk soil

Chalk soil can be either light or heavy but always highly alkaline due to the calcium carbonate or lime within its structure.

1.1.6 Loamy soil

Loamy soils are mixture of sand, silt and clay that are combined to avoid the negative effect of each type.

1.2. SOIL pH

Soil pH is a measure of acidity or basicity (alkalinity) of a soil. pH is **outlined** **because the** negative **exponent** (base 10) of the activity of hydronium ions (H+ or, more precisely, H3O+aq) in a solution.

In soils, **it's** measured **in a very** **suspension** of soil mixed with water (or a salt **resolution**, such as 0.01M $CaCl_2$), and normally falls between 3 and 10, with 7 being neutral. Acid soils have a pH below 7 alkaline soils have a pH above 7. Ultra-acidic soils (pH <3.5) and very strongly alkaline soils (pH >9) are rate.

1.3 SOIL ELECTRICAL CONDUCTIVITY

Soil **conduction** (EC) **may well be** a **activity** that correlates with soil properties that have **an impact** on crop productivity, including soil texture, cation exchange capacity (CEC), drainage conditions,organic matter level, salinity and subsoil characteristics. Electrical **conduction** (EC)is **the foremost** common **live** of soil salinity **associate degree**d is indicative of ability of **associate degree solution to hold** an electrical current.

1.4. PLANT NUTRIENTS

Soil **could be a** major **supply** of nutrients **required** by plants for growth.
The three main nutrients are nitrogen (N), phosphorus (P) and potassium (K).
Together **they create** up the trio **referred to as** NPK.
Other important nutrients are calcium, magnesium and sulphur.
Plants **conjointly want little** quantities of iron, manganese, zinc, copper, boron and molybdenum, known as trace elements because only traces are needed by the plant.

The role of these nutrients play in plant growth is complex.
The **seven** micronutrients **area unit adequate** in most soils **to satisfy** crop **desires**.
HoweverHowever, some sandy soils and **totally different** low organic matter soils **unit of measurement** naturally deficient in micronutrients, and high **hydrogen ion concentration** soils **might build** some micronutrients less **out there and thus** deficient.In the major crops and production areas of North America, the micronutrients **most frequently provided** by fertilization

2. EXPERIMENTAL WORK

2.1 SOIL pH

2.1.1 Principle

The pH of 1: 2: 5 soil water suspension is estimated using a pH meter. It is a measure of hydrogen ion activity of the soil water system and indicates whether the soil is acidic, neutral or alkaline in reaction.

2.1.2 Reagents

Standard buffer solutions

Prepare buffer solutions of pH 4.0, 7.0 and 9.2 using commercially available buffer tablets. Dissolve the respective tablets in freshly prepared distilled water and make up the volume to 100 mL. It is necessary to prepare fresh buffer solutions after every few days as these solutions should not keep for long time.

2.1.3 Procedure

Calibrate the pH meter using buffer solutions. The pH of soil is determined in 1: 2: 5 soil water suspension. Take 10 g sample of soil sieved through 2mm sieve in a 50- or 100-mL beaker. Add 25 mL distilled water, stir well for about 5 minutes and keep for half an hour. Stir well again and take the reading using the pH meter

2.2 ELECTRICAL CONDUCTIVITY

2.2.1 Principle

Electrical conductivity in soil water system is a measure of concentration of soluble salts and extent of salinity in the soil and measured using a conductivity meter.

2.2.2 Reagent

0.01 N Potassium chloride solution

Dry a small quantity of AR grade potassium chloride at 60^0 C for 2 hours in a hot air oven. Weigh 0.7456 g of it and dissolve in distilled water and make up to 1 litre. This solution gives an electrical conductivity of 1.41 dS m^{-1} at 25^0 C.

2.2.3 Procedure

The clear supernatant 1: 2: 5 soil water suspension prepared for pH measurement can be used for estimation of EC. Determine the conductivity of the supernatant liquid using a conductivity meter.

2.3 AVAILABLE PHOSPHORUS

Determination of plant available P in soil has two distinct phases, first extraction of plant available pool of phosphorus present in soil and then the quantitative determination of P in the extract. The choice of colorometric method for determining P depends on P concentration in the solution, the concentration of interfering substances in the solution to be analyzed and the particular acid system involved in the analytical procedure. The molybdenum blue method is the most sensitive and widely used one for soil extracts containing small amounts of P.

2.3.1 Principle

In an acid molybdate solution, the orthophosphate ions get precipitated as phosphomolybdate complex form that can be reduced by ascorbic acid, stannous chloride and other reducing agents. This reduced phosphomolybdate has blue colour. Intensity of the blue colour varies with P concentration but is affected by other factors such as acidity, arsenates, silicates and substances that influence the oxidation - reduction conditions of the system.

As the available pool of P varies depending on the pH of the soil, reagents used for extraction this pool also are different.

2.3.2 Available P in acidic soils

Available P is commonly extracted using Bray No.1 reagent (Bray and Kurtz, 1945), which consists of 0.03 N NH_4F and 0.025 N HCl. The combination of HCl and NH_4F is designed to remove easily acid soluble P forms, largely calcium phosphates and a portion of the aluminium and iron phosphates. The NH_4F dissolves aluminium and iron phosphates by its complex ion formation with these metal ions in acidic solution.

2.3.3 Reagents

Ammonium fluoride (NH_4F) 1 N: Dissolve 37g NH_4F in distilled water and dilute the solution to 1 litre. Store the solution in polythene bottle.

Hydrochloric acid 0.5 N: Dilute 20.2 mL concentrated HCl to a volume of 500 mL with distilled water.

Bray No.1 reagent: Add 15 mL 1N ammonium fluoride (NH_4F) and 25 mL0.5N Hydrochloric acid (HCl) in 460 mL distilled water. This solution can be kept in glass for more than one year.

Ammonium para molybdate ($(NH_4)_6Mo_7O_{24}.4H_{2O}O$): Dissolve 12g ammonium parmolybdate in 250 mL distilled water. Dissolve 0.2908 g potassium antimony tartarate ($KSbO.C_4H_4O_6$) in 100 mL distilled water. Add these dissolved reagents to 1 litre of 5N sulphuric acid (H_2SO_4) (141 mL of concentrated H_2SO_4 diluted to 1 litre), mix thoroughly and dilute with distilled water to 2 litres. Store in a pyrex glass bottle in a dark and cool compartment (reagent).

Ascorbic acid: Dissolve 1.056 g ascorbic acid in 200 mL reagent A and mix. Ascorbic acid (reagent) should br freshly prepared as and when required.

Standard phosphate solution: Dissolve 0.4393 g oven dry AR grade potassium dihydrogen phosphate (KH_2PO_4) in distilled water and dilute the solution to 1 L. One millilitre (1mL) of this solution contains 100 µg of P. From this solution, prepare a secondary standard of 2 µg mL^{-1} by pipetting2 mL and diluting to 100mL with distilled water.

2.3.4 Procedure

Extraction

Weight 5 g of soil into 100 mL conical flask and add 50 mL Bray No.1 reagent and shake for exactly 5 minutes. Filter through whatman No. 42 filter paper. To avoid interference of fluoride, 7.5 mL of 0.8 M boric acid (50 g of H_3BO_3 per litre) can be added to 5 mL of extract, if necessary. Estimate phosphorus in the extract by ascorbic acid method (Watanabe and Olsen, 1965).

Estimation by reduced molybdate blue color method

Pipette 5 mL of the extract into a 25 mL volumetric flask and dilute it to approximately 20 mL. Add 4 mL reagent B. Make up the volume with distilled water and shake the contents well. Read the intensity of colour after 10 minutes at 660 nm. The colour is stable for 24 hours and the maximum intensity develops within 10 minutes. The concentration of P in the sample is computed from the standard curve.

2.3.5 Preparation of standard curve

Prepare different concentrations of P taking 1,2, 3,4, 5 and 10 mL of of 2 µg mL^{-1} P solution in 25 mL volumetric flasks. Add 5 mL of the extracting reagent (Bray No.1) make up to

25 mL to get 0.08, 0.16, 0.24, 0.32, 0.4 and 0.8 2 µg mL^{-1} standards respectively and develop colour as described above by adding reagents. Read the absorbance for the standards and plot the concentration *v*s. absorbance curve on a graph paper.

2.4 AVAILABLE ZINC AND COPPER

The major categories of micronutrient extractants presently in use are dilute acids and solutions containing chelating agents such as DTPA or EDTA.

Dilute acids (0.025 to 0.1 M) have been used as micronutrient extractants for many years, primarily on acidic soils. Their applicability is confined to acidic soils because they generally are not sufficiently buffered to extract meaningful levels of micronutrient from calcareous soils. Acidic extractants do not have a particularly sound theoretical basis, but due to their extensive use in field and laboratory studies, a well-developed database exists relating acid extractable levels of micronutrients to crop response. The most commonly used dilute acids are Mehlich 1 (dilute double acid, 0.0125 M H_2SO_4=0.05 M HCl) and 0.1 M HCl.

Among the chelating agents, DTPA is the most commonly used one. The DTPA soil test, developed for near neutral and calcareous soil by Lindasy and Norvell (1978) illustrates the evolution of a soil test extractant from theoretical principles. The extracting solution consists of 0.005 M DTPA and 0.01 M $CaCl_2.2H_2O$, buffered at pH 7.3 by 0.1 M triethanolamine (TEA). The DTPA extractant offered the most favorable combination of stability constants necessary to simultaneously extract four micronutrient cations (Fe, Mn, Cu, and Zn). The buffered pH and presence of soluble Ca^{2+} prevent excessive dissolution of calcium carbonate avoiding the release of unavailable micronutrients occluded by this solid phase. At pH 7.3, 70-80% of the buffering capacity provided by TEA has been consumed. Therefore, use of DTPA extractant on acidic soils is not recommended, since it results in neutralization of remaining buffer capacity and unpredictable extraction pH.

2.4.1 Reagents

Hydrochloric acid (HCl) 0.1 M: Add 8.1 mL concentrated HCl (reagent grade) to approximately 900 mL distilled water, mix, cool to room temperature and make up to 1 L.

DTPA: Prepare the extractant by dissolving 1.967 g DTPA, 14.9 G TEA and 1.47 g $CaCl_2$. $2H_2O$ in 200 mL distilled water and dilute to approximately 900 mL. Adjust the pH to 7.3 ± 0.05 with 1:1 HCl and make up the volume to 1 L.

2.4.2 Estimation of zinc and copper in acid soils (pH < 6.5)

Extraction and estimation

Shake 2 g of soil with 20 mL 0.1 M HCl for 5 minutes. Filter through Whatman No. 42 filter paper. Collect the filtrate and estimate the contents of Zn using an atomic absorption spectrophotometer.

3. RESULT & DISCUSSION

The soil physico-chemical parameters monitored at different sites and collected 10 samples from each site at sub-surface soil of depth 10-20cm.The characteristic physico-chemical parameters for soil samples are given below

DISCUSSION

The purpose of soil testing is to give the individual farmers dependable information regarding fertilizer and lime needs. However, all cultivators will not be able to test their soils. Soil test information has therefore to be compiled soil wise, or area wise in the form of soil test summaries, which will help in getting an idea of fertilizer requirements for that area. From the study, the pH of all the samples is less than 7, so the collected soils are acidic in nature. All the samples show low electrical conductivity; hence they are less saline. The amount of phosphorus is high in sample 8 & 9. The amount of zinc is high in sample 9. The amount of copper is high in sample 8. Fertilizer is essential for the soil samples containing low amount of P, Zn & Cu.

4.CONCLUSION

Proper nutrition **is crucial** for satisfactory crop growth and production.
The use of soil tests **will facilitate to work out** the **standing** of plant **accessible** nutrients to develop **chemical** recommendations **to realize** optimum crop production.
Efficient application of the correct types and amounts of fertilizers for the supply of nutrients is an important part of achieving profitable yields. Phosphorus (P) is essential for all living organisms.
Plants **should** have phosphorus for **traditional** growth and maturity.

Phosphorus plays **a task** in **chemical process**, respiration, energy storage and transfer, cell division, cell enlargement and several other processes in plants.
A plant **should** have phosphorus **to complete** its **traditional** production cycle.

Phosphorus deficiency is **harder** to diagnose than a deficiency of **gas** or **metal**.
Crops **typically show** no obvious symptoms of phosphorus deficiency **aside from** a general **stunt flying** of the plant **throughout** early growth.
Some crops, **like** corn, tend to show an abnormal discoloration when phosphorus is deficient.
The plants **square measure typically** dark bluish-green in color with leaves and stem **turning into purple**.
Phosphorus **is very** mobile in plants, and when deficient, it may be translocated from old plant tissue to young, actively growing areas.
Consequently, early vegetative responses to phosphorus are often observed.
The percentage of **the entire quantity of every** nutrient **obsessed** is higher for phosphorus late **within the season** than for either **gas** or **metal**.
Farmers and gardeners apply phosphate-based **chemical** to plants and soil **to spice up native** phosphorus (P) levels.

Phosphate fertilizers fall into one of four basic categories: rock phosphates, superphosphates, ammonium phosphates or polyphosphates. Each type of fertilizer is composed of different substances and chemical ratios.

COPPER

Copper (Cu) is **one amongst** the micronutrients **required** in **terribly tiny** quantities by plants.
The normal **target** the growing medium is **zero**.05-0.5 ppm, **whereas** in most tissues **the conventional vary** is between 3-10 ppm.
In comparison, **the best vary** for iron **within the** tissue is **twenty** times **over** that of copper..
Although copper deficiencies or toxicities **seldom** occur, it is best to avoid either extreme as both can have a negative impact on crop growth and quality.
It is **conjointly needed within the method** of **chemical action**, is essential in plant respiration and assists in plant metabolism of carbohydrates and proteins.
Symptoms vary depending on the crop. Typically, the symptoms start as cupping and a slight chlorosis of either the whole leaf or between the veins of the new leaves.
Within the **iron deficiency anemia** areas of the leaf, small necrotic spots may form, especially on the leaf margins.
As the symptoms progress, the newest leaves are smaller in size, lose their sheen and in some cases the leaves may wilt. The apical meristems may become necrotic and die, inhibiting the growth of lateral branches.
Plants **usually** have a compact **look because the** stem length between the leaves shortens.
Flower color is often lighter than normal. Excess potassium, phosphorus or other micronutrients can indirectly cause copper deficiency. Also, if the pH of the growing medium is high, this can induce a copper deficiency as it is less available for plant uptake. Copper sulfate is the preferred source of copper fertilizer because of low cost compared to chelated sources. Some commonly used copper fertilizers are copper chelate (Na_2Cu EDTA), cupric ammonium phosphate ($Cu(NH_4)PO_4.H_2O$), cupric chloride ($CuCl_2$), cupric oxide (CuO), cuprous oxide(Cu_2O).

Copper use **potency** is improved if the **fertiliser** is water soluble **and also the** particle size of the **fertiliser is tiny**.
A single application of copper **will** last **for several** years.

Zinc, **one in every of** the essential micronutrients and **a very important** constituent of **many** enzymes and proteins, **is barely required** by plants in **tiny** quantities.
Zinc activates enzymes that **square measure liable for** the synthesis of **bound** proteins.
It is **utilized in** the formation of **pigment and a few** carbohydrates, conversion of starches to sugars and its presence in **plant part** helps the plant **to resist** cold temperatures.
Zinc **is important within the** formation of auxins, **that facilitate** with growth regulation and stem elongation.
Zinc **salt**, **ammonia metal**, and **chelate metal square measure 3 plant food choices**.
Sulfates **square measure the foremost usually** applied inorganic **metal plant food**.
Zinc sulfate **could be a** granular product **which will** be banded or broadcast.
There are two forms of zinc sulfate they are, zinc monohydrate with 36% zinc and zinc heptahydrate with 22% zinc. Zinc monohydrate is commonly used due availability, higher zinc content per pound and low water content resulting in lower transportation costs. Zinc ammonia complexes are typically found in starter fertilizers. They work well in liquid blends made from ammonium phosphate. Specific ammoniated zinc solutions can also be mixed with UAN or aqua ammonia solutions

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