Project work
On

A COMPARATIVE STUDY OF NPK VALUES OF ORAGANIC FERTILIZERS

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By

NAICY T.C.
Reg. No. 71171

LEAD KINDLY LIGHT

DEPARTMENT OF CHEMISTRY
NEWMAN COLLEGE
THODUPUZHA

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CERTIFICATE

This is to Certify that the project work entitled **"A COMPARATIVE STUDY OF NPK VALUES OF ORGANIC FERTILIZERS"** is a bonafide piece of research work done by **NAICY T.C.** at **RUBBER RESEARCH INSTITUTE OF INDIA, PUTHUPPALLY, KOTTAYAM** under my guidance and support and submitted to **MAHATMA GANDHI UNIVERSITY** in partial fulfillment of the requirements for the award of **MASTER OF SCIENCE (CHEMISTRY) DEGREE COURSE**. I certify that the report has not been presented for any other degree or diploma.

Prof. Dolly Joseph
Supervising teacher
Department of Chemistry
Newman College
Thodupuzha

24-08-07

Forwarded by

Prof. Glory Varkey
Head of the Department
Department of Chemistry
Newman College, Thodupuzha

DEPARTMENT OF CHEMISTRY
THODUPUZHA
NEWMAN COLLEGE

DECLARATION

I, Naicy T.C. here by declare that the project work entitled **"A COMPARATIVE STUDY OF NPK VALUES OF ORGANIC FERTILIZERS"** is an authentic record of original work carried out by me under the super vision and guidance of Prof. Dolly Joseph, Department of Chemistry, Newman College Thodupuzha and Dr. Reethamma Joseph, Scientific Assistant, Rubber Research Institute of India, Puthuppally, Kottayam. This project report has not been submitted for any other degree or diploma earlier.

NAICY T.C.
Reg. No. 71171

Newman College
Thodupuzha

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NAICY T.C.
Newman College
Thodupuzha

CONTENTS

CHAPTER – I

INTRODUCTION

The greatest challenge facing mankind in the 21st century is to produce the basic necessities of food feed, fiber, fuel and raw materials from 0.14 hectare or less land per capita. While the use of mineral fertilizers is the quickest and surest way of boosting crop production, farmers frequently use them in recommended quantities and in balanced proportions. But complementary use of available renewable sources of plant nutrients (organic/biological) along with mineral fertilizers is of great importance for the maintenance of soil productivity, ie, soil structure, soil bioactivity, soil exchange capacity and water holding capacity. Results from various cropping systems and ecologies illustrate that positive interactions result from the integrated use of mineral fertilizers and organic/biological sources of plant nutrients.

Plants require at least 14 mineral elements for their growth and development. All these essential nutrients are present in all soils but one or more of them is invariably present in inadequate amounts of plant- usable form which makes external additions if necessary, since each element has certain specific functions to perform, one cannot substitute for another. If a soil is deficient in even one nutrient, it cannot support a good crop unless deficiency of this element is made up.

A crop is concerned more with the amounts of nutrients available for its use rather than where they have come from. Diverse sources of nutrients can be gainfully used as long as they are able to furnish the nutrients in readily or potentially usable forms.

1. THE NECESSITY OF FERTILIZERS

Fertilizers are mined or manufactured products which contain one or more essential plant nutrients. For a material to qualify as a fertilizer, it should contain nutrients in appreciable amount and in readily or potentially usable form. In addition a fertilizer, just like any food item, should not contain or produce any, substance which is toxic to the soil, plants or humans above permissible limits.

Fertilizers are used with the sole purpose of improving soil fertility so that it can support larger harvest. Fertilizers represent the most common currency used by farmers to deposit nutrients into their soils to ensure that adequate nutrients are available to feed the crop. Plan't roots do not absorb fertilizer granules as they come out of the bag or dung particles as they are in manure heap. Plants absorb nutrients in specific ionic forms, which either a fertilizer furnishes when it dissolves in soil water or various chemical and biological agents in the soil water or various chemical and biological agents in the soil convert fertilizer in to the absorbable form.

2. TYPES OF FERTILIZERS

Fertilizers are of two types – chemical & biological. Chemical fertilizers are synthetic or chemical formulations that supply the soil with requisite minerals directly. Mostly they are inorganic. Chemical fertilizers are mostly synthesized from fossil fuels. Biological fertilizers are nutrient materials obtained from living organisms or their organic remains which are used for enhancing fertility of soil. Biological fertilizers are of two types – manures and biofertilizers.

Manures

Manure is a semi-decayed organic matter which is added to the soil in order to maintain its fertility, crumb structure, aerations and hydration capacities. It is of three types – farmyard manure, compost and green manure.

Farmyard Manure

Dung, farm refuse, leaves, twigs, etc are dumped in heaps to undergo decomposition and form dark amorphous manure.

Compost/Composited Manure

It is rotten vegetable matter, garbage, sewage sludge and animal refuse often enriched with small amount of chemical fertilizers during decomposition stage.

Green Manure

Ghai and Thomas (1989) have defined green manuring as a farming practice where a leguminous plant which had derived enough benefits from its association with appropriate species of Rhizobium is ploughed in to the soil and then a non-legume is grown and allowed to take the benefits of the already fixed nitrogen. Various leguminous plants to be used to green manure are: cultivated annual legumes, perennial legumes and wild annual legumes.

In addition to nitrogen , green manures also provide organic matter, N,P,K, and minimize the number of pathogenic micro-organisms in soil.

Bio-Fertilizers

The term 'biofertilizers' denotes all the nutrient inputs of biological origin for plant growth. In other words biofertilizers are organisms that enrich the nutrient quality of the soil by enhancing the availability of nutrients like nitrogen (N) and phosphorous (P) to the crops.

The use of chemical fertilizers, insecticides and pesticides has caused tremendous harm to the environment. An answer to this problem is the biofertilizer ie, fertilizers of biological origin which are both economically and ecologically safe to use.

3. CONSTITUENTS OF FERTILIZERS

There are 14 food elements or nutrients which plants need for their growth. They are Carbon, Nitrogen, Hydrogen, Oxygen, Phosphorous, Potassium, Calcium, Magnesium, Sulphur, Iron, Manganese, Boron, Copper & Zinc. Every one of these elements is needed by our crops from which men and animals get their food supply. Just as young boys and girls need certain quantities of the necessary food for their growth so also an exact amount of any one of these nutrients is too small to meet that is needed for proper growth, the crop will not grow well and, consequently, the yield will be reduced. While a number of elements are essential to the growth of plants, experience has shown that in general the fertility of the soil may be maintained by the addition of four substances: (1) nitrogeneous matter (2) phosphates (3) compounds of potassium & (4) compounds of sulphur. Recent experiments indicate that the three primary elements which are likely to be deficient in most soils are nitrogen, phosphorus, and potassium. A second group calcium, magnesium, and sulphur may also be deficient in soil. Smaller amounts of a 3rd group, known as the trace elements, must also be available. The trace elements include iron, manganese, copper, zinc, boron & iodine. The soil does not contain an inexhaustible supply of these minerals. Thus we must add fertilizer each year to maintain the productivity of the land.

3.1. The big three in fertilizer elements

Nitrogen, phosphorous, and potassium are the "big three" among fertilizer elements. This is because they are needed in greater amounts than the other elements and are more apt to be deficient in soil. Fertilizers containing all three are often called complete fertilizers. However, a really complete fertilizer should also contain the "little three", calcium, magnesium, and sulphur, as well as the trace elements. Nitrogen is usually expressed as "equal to a definite percentage of nitrogen". Phosphorous is expressed as "equal to a certain amount of phosphorous pentoxide". Potassium is stated as "equal to a certain amount of potassium oxide". These elements are usually given in that order. Thus a 4-8-4 fertilizer has 4% N, 8% P_2O_5 & 4% K_2O. Besides the total amount of each element, most brands indicate what percentage is water soluble. Scientific farmers choose their fertilizer according to the crop they are to raise. Lettuce and other leafy crops require large amount of nitrogen. Phosphorous is needed expecially for seed crops such as corn. Potatoes and other root crops require fertilizer that is rich in potassium. Mixtures containing different percentages of the "big three" are prepared by fertilizer companies for a particular kind of crop.

The sources of NPK

Sodiun, Calcium and Ammonium Nitrates are produced in large quantities from synthetic nitric acid for fertilizer. Sodium nitrate from chile, called chile saltpeter, has also been an important source of nitrogen. Waste from fish canneries is similarly treated and is a good source of nitriogen. Synthetic ammonia is now being added directly to the soil in a process called nitrogenation. By-product ammonia from gas works is converted into ammonium sulfate or ammonium phosphate and finds a ready sale as a component of fertilizer.

The calcium phosphate deposits in Florida, Tennessee, and other southern states furnish the main source of phosphate for fertilizer. Dried bones from slaughterhouses are ground to a fine powder which is called bone meal. Bone meal is rich in calcium phosphate although it dissolves more slowly in the soil than calcium acid phosphate.

Wood ashes are rich in potassium compounds or "potash". Most of our potassium fertilizer comes from the potash mines in Texas and New Mexico. Large amounts are also extracted from the concentrated salt water of Searles Lake in California. Sugar beet wastes, the flue dust from cement kilns, and even the washings from sheep's wool contain various amounts of potassium compounds as fertilizers.

3.2 The little three fertilizers

Calcium, magnesium, and sulphur may or may not, be precent in sufficient amounts in a given patch of ground. Lime, in the form of calcium carbonate, calcium hydroxide, or pulverized limestone, is commonly added to land to neutralize the soil acid. This process supplies sufficient calcium as well. Some agricultural lime is a mixture of calcium and magnesium carbonates. Both are of value for neutralizing acid, and both supply useful elements. Magnesium sulphate is sometimes added to mixed fertilizer to supply both magnesium and sulphur. The deficiency of magnesium in the soil is evident by a yellowing of the leaves of plants.

3.3 Trace elements

The trace elements are needed in very small amounts. Yet, if one or more of these is completely missing, plants will not thrive. Fortunately, a mixed fertilizer usually contains sufficient trace elements as impurities. Special preparations that contain all of the trace elements are now available from fertilizer dealers. By adding small amounts of one of these preparations, we can be sure that all of these elements will be available.

4. EFFECT OF ORGANIC FERTILIZERS

The plant food elements in the soil are found both in the organic matter and mineral particles. The soil organic matter was derived from plants. The plants growing on the soil absorb the food element from the organic matter. Particularly the whole of the nitrogen present in the form of protein or other related compounds. The nutrients present in the mineral particles of the soil are all derived from the rocks and minerals from which the soil was formed.

Protein is a substance of great value in human food and in the feed.of animals. It builds and strengthens the muscles. N & P are of special importance in the building up of protein in plants. For this reason crops must have plenty of there elements to build up large amounts of protein. Ca is needed in large quantities, especially by legumes. It is of special value in the production of protein in the crops. K is necessary for building up sugars and starches though the element itself doesnot from a part of these substances. Magnesium is closely related to calcium and has some what the same effect on crops.

Decayed organic matter, called humus, retains moisture and prevents the soil from packing together so firmly that roots cannot spread out easily. Humus also provides a medium in which helpful soil bacteria can supply.

The manure from farm animals is a valuable by-product that should be returned to the soil. It varies in composition depending on the age, type and diet of animals. Cattle fattened on grain will produce a richer manure than grass – fed stock. Poultry manures contain more nitrogen and less water than that from cows. A rough estimate of the composition of one ton of manure includes, among others the following: 10lb of nitrogen, 2lb of phosphorous & 8lb of potassium. Other elements are also present.

The organic matter in a piece of ground is increased by growing a crop and then plowing it under as green manure. Plants have nodules on their roots contain nitrogen fixing bacteria. By the action of these bacteria, nitrogen from the air is converted into nitrates. When the crop is ploughed under and undergoes decay, the nitrogen content of the soil is greatly enriched.

Compost is the product of the decay of waste plant material. Grass clippings, waste leaves, corn stalks, and all other garden wastes should be put on the compost pile. Alternate layers of vegetable matter and garden soil to which a sprinkling of lime has been added, should be piled to some convenient height. The pile must be kept moist but not wet. After about six months the compost should be ready for use. It will be dark brown, and smell sweet like soil from the forest.

CHAPTER 2

ELEMENTS ESSENTIAL FOR PLANT LIFE

The soil contains most of the known elements in various concentrations. Some of the elements such as oxygen, silicon, aluminium, iron, calcium and sodium are present in large amounts. While many others such as silver, selenium and molybdenum are present only in traces. Naturally the fruit plants take up most of these elements from the soil. Only 17 of these elements are, however, essential for the growth and development of plants and their exact role in the physiological processes is more or less known. On the other hand, several other elements taken up by the plant are not essential and the roles they play in plant life are not yet known.

According to Arnon (1950), an essential element must satisfy the following three conditions.

1. A deficiency of it makes it impossible for the plant to complete its life cycle;

2. Such deficiency is specific to the element and can be prevented or corrected only by supplying this element; and

3. The element is directly involved in nutrition of the plant quite apart from its possible effects in correcting some unfavourable microbial or chemical condition of the soil or other culture medium.

1. NITROGEN

Nitrogen (N) plays a key role in the nutrition of plants. As a matter of fact, plant life would not be possible without this element. Green plants are more markedly influenced by the presence or lack of N than by any other element. It is, however, interesting that this element is not found in parent soil minerals. On the other hand, it is added to the soil from atmosphere through rain water and biological agencies such as N- fixing bacteria.

1.1 Functions of nitrogen

Nitrogen has many functions in plant life. Being a part of proteins, it is an important constituent of protoplasm. Enzymes have N as their major constituent. Nitrogen also occurs as nucleoproteins, amino acids, amines, amino sugars, polypeptides and many other organic compounds in plant system. A sufficient supply of various nitrogeneous compounds is, therefore,required in each plant cell for its proper functioning. Some non-protein N compounds such as cellulose and lignin which are not very active biologically, play an important role in building plat structure.

1.2 Natural sources of N in soil

One of the natural sources of nitrogen is the organic matter originating from both plants and animals. Nitrogen constitutes about 5-6 percent of soil organic matter by weight. Nitrogen is also added to the soil by symbiotic and non-symbiotic fixation from the atmosphere.

Rainfall is also responsible for the addition of some N to the soil. Oxides of N are formed in the atmosphere by lightening which are then washed down to the soil by the help of rain water.

Although all these sources add considerable amount of N to the soil, most of the N of the earth, however, is present not as soil N but as molecular N_2 in the atmosphere.

Organic Sources

a. Natural Organic materials

The natural organic materials which supply N include farmyard manure, oil cakes, dried blood, fish manure, green manure, sewage products and castor pomace. Among the oil cakes – castor cake, neem cake, Karanj cake and mahua cake are most commonly used as manure. The N of the mahua cakes becomes available after two months while that of the castor, neem and Karanj cakes becomes available in about a week or ten days time.

b. Synthetic Organic N

Materials containing synthetic organic N are readily soluble in water.

(i) Calcium cynamide

Based on the cost per unit of N, this fertilizer is more expensive than the other nitrogenous fertilizers. Calcium cynamide, however, possess certain advantages. Its high calcium content and the alkaline reaction make it a good material for use on acid soils. Where the soils contain enough organic matter and moisture, this can be used with advantage for many fruit trees.

Calcium cynamide is converted to urea in the soil in the presence of water which is further broken down to ammonia and CO_2.

(ii) Urea

The use of urea has been increasing in India. Urea contains 46 percent N and is the most highly concentrated nitrogenous fertilizer in solid form. Because it is not combined with any inorganic substances, urea has no effect at all on the soil reaction. Urea is highly soluble in water, can readily be absorbed through the leaves and is, frequently applied in the form of nutrient sprays.

Inorganic sources

(a) Chilean nitrate of soda or saltpeter.

This is the form of inorganic N, which first became available in the world market. At present it constitutes about three percent of the fertilizer N.

(b) Ammonium Sulphate

This is one of the most commonly used fertilizers in India. This salt absorbs very little moisture but is very soluble in water. This fertilizer is easy to handle and stores well in dry conditions. The N contained by this salt is cheaper than that carried by Sodium Nitrate and is readily available to plants under favourable conditions.

(c) Ammonium Nitrate

This fertilizer has overtaken ammonium sulphate as the most important N- fertilizer in the world. It has the advantage of supplying both nitrate and ammoniacal N. This fertilizer contains almost double the quantity of N as contained by sodium nitrate and is a quick acting material. This material is very dangerous in case of fire because of its explosive nature. This is also an acid forming fertilizer but only half as much as produced by ammonium sulphate.

1.3. Deficiency Symptoms of N

The Indian soils being low in N, the fruit trees grown under such conditions usually show signs of N deficiency. The nitrogen deficiency symptoms are quite characteristic and can be recognized very easily.

The tops, shoots and roots of N-deficient trees are stunted. The shoots are usually upright and spindly. The leaves of such plants are small, usually pale yellowish in the early stages, later developing highly coloured tints of yellow, orange and red. The N-deficiency symptoms first appear on the old leaves and provide towards the younger leaves. Defoliation is premature. There is a marked reddening of bark and the fruits are hard and small.

2. PHOSPHOROUS

Phosphorous became prominent as a plant nutrient comparatively, earlier than many other elements.

2.1. Functions of P

Phosphorus is a constituent of all plant tissues and is found especially concentrated in younger parts, in flowers and the seed. This element is particularly important in germination of seeds, stimulation of root growth and ripening processes of seeds and fruits. Phosphorous is essential for cell division and the development of meristematic tissue.

Phosphorous is a constituent of many compound in the plants such as nucleic acids, phytins, phospholipids, the coenzymes nicotinamideadenine – dinucleotide (NAD), NADP & ATP. The coenzymes NAD and NADP are involved in oxidation – reduction reactions and many vital plant processes such as photosynthesis, glycolysis, respiration, and fatty acid synthesis are dependent on these coenzymes. All biochemical processes such as molecule synthesis and uptake and transport of some ions, which need energy depend on the supply of ATP.

2.2. Natural sources of P in the soil

Both organic and inorganic forms of P exist in the soil. The organic fraction, which includes phospholipids, nucleic acids, inositol phosphates and several unidentified forms constitutes 2.6 to 75 percent of the total soil P and is inert.

The inorganic P is the soil originated from the disintegreation and decomposition of rocks containing the apatite group of minerals, Ca_{10}, $(PO_4)_6$, $(F, Cl,OH)_2$ and may be found in the soil as finely divided fluorapatite, hydroxyapatite and chlorapatite, iron-or aluminium phosphatic; or in combination with the clay fraction.

2.3 Phosphorus materials

Phosphorus has been used to fertilize the soil for a long time. During the early nineteenth century most of this element was derived from organic sources such as bones and tankage. At first the raw bones were usually used for this purpose but later on they were collected and processed into a number of products such as bone meal. Bone meal contains bout 9.5 – 10.5 per cent P and is almost as effective as superphosphate. Sometimes both fats and proteins are removed from the crushed bones. This material is referred to as steamed bone flour and contains about 12-13 percent P.

The supply of these organic fertilizer materials has always been inadequate. Extension of areas under fruits, vegetables and other crops created a tremendous demand for phosphatic fertilizers. The phosphatic fertilizers are classified into three main groups, based on the mode of combination as well as the availability of P contained in them.

1. Phosphatic fertilizers with the water soluble P

This group comprises quick-acting fertilizers and are especially beneficial for young plants planted on virgin soils. They include:

(a) Superphosphate

This is the most important material of all the phosphatic fertilizers supplying readily available P.

(b) Double or triple superphosphate

This is a concentrated form of superphosphate. For the manufacture of this material, the rock phosphate is treated with sufficient phosphoric acid to convert all the rock phosphate to monocalcium phosphate. The term triple superphosphate is used to indicate 3 times the P contained by it.

2. Phosphatic fertilizers in which P is soluble in citric acid or ammonium citrate.

This group includes materials such as basic slag and dicalcium phosphate. The fertilizers of this group are especially suitable for the treatment of acid soils because in their case the danger of the irreversible fixation of P as phosphates of iron and aluminium is less than with the water soluble phosphatic fertilizers.

3. Rock Phosphates

The P content of these materials usually ranges between 11-15 percent. The P in this group of materials is not soluble either in water, citric acid or ammonium citrate. The rock phosphates are the raw materials used in the manufacture of the phosphatic fertilizers such as single and double superphosphate and mono & di ammonium phosphates. The finely ground rock phosphates have a special advantage in that they are useful for application on acid soils with pH around 4.3.

2.4. Causes & Symptoms of P Deficiency

Phosphorus deficiency may occur in areas of high rainfall. This may be due to two causes. (1) occurrence in these areas of acid soils in which phosphates are quickly rendered unavailable (2) high rainfall may cause actual leaching and errosion of phosphates. Although the losses due to these factors are very small, yet occurring over centuries, they do deplete soil of some amount of P.

Phosphorus deficienct plants show growth retardation especially in the case of root development. The shoots are short, thin and spindly, leaves are small and defoliation, which starts from the older leaves, is premature. Flowering is greatly reduced and the yields are poor. Fruit maturity is delayed. There is purplish discolouration of foliage and the tips of older leaves are often dead.

3. POTASSIUM

Unlike nitrogen and phosphorus which are parts of molecular structure of many organic compounds in the plants, potassium (K) does not enter into the composition of any of the important constituents of the plant cells such as proteins, chlorophyll, fats and carbohydrates. Potassium is, however, required by plants in fairly large amounts and occurs primarily as soluble inorganic salts and occasionally as salts of organic acids. This element seems to be of special importance in young leaves, root tips and other meristematic tissues as they are very rich in K.

3.1 Functions of K

Functions of potassium is involved in almost all the metabolic processes in the plant. This element plays an important role in photosynthesis and helps in the building up of carbohydrates. It has been recognized that K has some part in protein synthesis as this element has a role in the reduction of nitrates and assists in the utilization of ammonium ions in amino acids and/or protein synthesis.

Potassium acts as an activator for a number of complex enzyme systems. These enzyme catalyse metabolic reactions related to carbohydrates, nucleic acid and nucleotides, amino acids, protein synthesis and folic acid.

Potassium plays a significant role in the regulation of transpiration and water conditions in the plant cell. Potassium is specially required for opening of stomata by light, no other physiological ion can substitute for K in this crucial role.

Potassium encourages root development in plants. This element plays a part in cell division. When the supply of this element is limited, it moves to the growing tips. Consequently the deficiency symptoms of K usually first appear in the older leaves.

3.2. Natural sources of K in soil

Compared with P, K is present in relatively large quantities in most soil. The earth's crust has only 0.11 per cent P but the K content, on the other hand, is 2.40 percent. The K contained in the soil arises from the disintegration and decomposition of rocks containing K bearing minerals. The minerals that generally considered the sources of K are the potash feldspars, muscovite and biotite. Potassium is also found in the soil in the form of clay minerals .

Soil K is generally classified into three categories depending upon its availability to plants and the way it is held in the soil. (a) The nonexchangeable K is a structural constituent of minerals such as feldspars and micas which occur in the sand, silt and coarse clay fractions of the soil. (b) Exchangeable K,which is absorbed on the surface of the soil colloids and organic matter against negative charge and constitutes about to 3 percent of the total soil charge and constitutes about 1 to 3 percent of the total soil K. The exchangeable K is the most important source of readily available K for plants and generally, there is significant correlation between this fraction of soil K and leaf K. (c) Water soluble K. This moves freely with soil water and makes up only a small fraction of exchangeable K, usually 1 to 5 percent. This form of K is the most immediate source of K for plants and is absorbed by their roots from the soil solution.

3.3 Fertilizer Materials

As compared with nitrogenous & phosphatic fertilizers, very little K fertilizers are manufactured. The ore is mined, purified and used as a straight fertilizer or mixed with other materials.

(1) Potassium Chloride

Potassium in commercial fertilizers is supplied chiefly in the form of potassium chloride. This fertilizer is commonly called "muriate of potash" and is available in several grades. It contains substantial quantity of sodium chloride and magnesium chloride as impurity. Potassium in this source is readily available. Potassium chloride has a high K content and is a neutral salt. More than 90 percent of K used in agriculture is supplied through this source.

(2) Sulphate of potash

'Sulphate of potash' – potassium sulphate is the 2nd most commonly used potassium fertilizer and accounts for 6 – 7percent of total world K consumption. This fertilizer is more expensive and contains less K. Sulphate of potash is neutral in its effect on soil.

(3) Sulphate of potash magnesia

This fertilizer contains both K and Mg in the sulphate form. It is a very good material where both these elements are required and is produced in large quantities in the United States.

3.4. Symptoms of K Deficiency

Potassium – deficiency symptoms first appear on the recently matured leaves as yellowing of the tips and margins and are particularly marked in dry season. With more acute deficiency, the yellowing zones extend near to the center or toward the leaf bases and symptoms also appear on young, immature leaves on the growing tips. As the growing period advances, the yellow parts of the leaves becomes necrotic, turning reddish brown or brownish grey. The yellow or necrotic areas and the healthy tissue of the leaves are demarcated sharply.

CHAPTER -3

EXPERIMENTAL TECHNIQUES

1. MATERIALS & METHODS

The following compounds are used for studying the NPK values.

1. Vermi compost
2. Neem cake
3. coconut cake
4. Ground nut cake
5. Sugarcane press mud
6. Tea press mud

1. VERMI COMPOST

Enriched biomass is known as compost, certain basic principles must be applied to increase the nutrient content of the biomass while composting. The decomposition of organic matter in the compost depends upon the temperature and moisture at different stages of decomposition. The materials used for composting should be in right proportion. Woody and bigger pieces take a longer time to decompose, as the surface area becomes smaller compared to the density, and this limits the activity of microorganisms. Very small pieces such as sawdust are also not desirable, as it becomes very compact when heaps become bigger.

The fermenting mixture soon becomes acidic in reaction to the production of humus. Acidity must be neutralized to make the micro-organisms work at the required speed. A base is therefore necessary.

Abundant aeration is also essential during the early stages of decomposing.

Among several hundreds of species of earthworms available, only a few species are amenable for confined culture and composing. In recent years, vermicomposting is done commercially and several hundreds of tones of vermi compost are being produced at several places and being sold in bags of 25 kg or 50kg like fertilizers.

. Vermi compost is popular among both the learned and the laymen for several reasons. Vermi composting does not need costly equipment and no high technology. Anybody can practice it depending upon the availability of biological waste and the quantity needed. It has become quite popular among housewives practicing terrace gardening or kitchen gardening, either for vegetables or ornamental plants. Since the nutrients in the vermi compost are readily available for plants, the growth and responses of plants are visible. Vermi compost alone cannot provide all the nutrients needed by the field crops, as some believe. The quality of the vermi compost depends on the quality of feed. Biomass with rich nutrients such as dung, poultry manure, press mud, green leaves and so on produces better quality vermi compost. Straw and dried leaves with no adequate animal excreta produce low quality compost. Worms cannot convert low quality biomass into high nutrient rich vermi compost.

Normally, the vermi pit is a metre wide, 30 to 40 cm high and any convenient length. The biomass with some amount of dung, decomposed for three to four weeks, should be spread to a thickness of 30 cm before allowing the worms in the pit. About 60 to 70 kg of semi decomposed material is needed for 1,000 to 1,500 worms to begin with. The worms will enter into the waste, if it is suitably decomposed; otherwise, they start crawling to the surface. In such cases some dung may be added. In about 15 to 20 days, 70 to 80 percent of the waste is consumed and converted into worm cast. To separate the vermi compost, the entire compost along with the worms is removed and heaped on the surface. After 24 hrs, the worms gather at the bottom like a ball, which can be separated. The compost is sieved in a 3mm mesh used for sieving sand for construction. The undigested material, cocoon and the worms are again transferred to the pit as before into the fresh decomposed bed.

A kilogram of worms (1000 – 1500) allowed into 100 kg biomass, produces 50 to 60 kg vermi compost in three months and 1.3 to 1.5 worms. In a shallow pit with a temperature of 25 to 30°C, 5 kg worms can produce 20,000 kg vermi compost in one year, in addition to 4 to 5 kg worms. In large scale production, the biomass, devoid of metal, glass, plastic and rubber, is cut into small bits, mixed with dung allowed for three weeks to decompose and then transferred to the rearing house, after which the worms are allowed in. The worm casts are collected from the surface daily. After 70 to 80 per cent of the mass is emptied,the whole mass is taken out, heaped, the worms and undigested materials are separated and recycled in a fresh vat.

2. NEEM CAKE

Neem cake , an organic manure is the by - product obtained in the process of cold pressing of neem fruit and Kernels and the solvent extraction process for neem oil cake.

Neem cake organic manure is used directly and/or in blends with area or with other organic manure like seaweed or farmyard manure to an extent of 15-20% wt for higher yields in various crops.

Neem cake organic manure has more oil, phosphorus, calcium and magnesium than the FYM. It is rich in saturated compounds as well as better limnoids.

There are many advantages for neem cake such as

- It acts as an organic manure and pest repellent on all types of crops and soil.
- Acts as a natural fertilizer with pesticidul properties.
- Protects plant roots from nematodes, soil grabs and white ants.
- Improves the soil considerably and protects the soil during drought.
- Increases crop yield substantially.
- Minimises the requirement of nitrogen in energy production and hence reduces the cost of fertilizer application.

3. COCONUT CAKE

Two types of copra namely milling & edible are made in India. Milling copra is used to extract oil while edible grade of copra is consumed as a dry fruit and used for religious purposes. Milling copra is generally manufactured by adopting sun drying and artificial means; substantial quantity of milling copra is manufactured using modern hot air driers resulting in the availability of superior quality copra which is required for the manufacture of best grade coconut oil. A good of farmers co-operative societies are also marketing of milling copra. Milling copra is available in different grades. Edible copra is made in the form of balls and cups. Different grades of edible copra are available in the market according to the size; colour etc.

Coconut cake is the residue left after the extraction of oil from copra which is mainly used as a cattle feed. Coconut cake contains 4-5 percent oil which is extracted by solvent extraction process. The oil is generally used for industrial purposes and de-oiled cake is used to make cattle feed. There are a few such units in the country especially in Kerala.

4. GROUNDNUT CAKE

Groundnut is the major oilseed crop in India account for 45% of oilseed area and 55% of oilseed production in the country. Groundnut is believed to be the native of Brazil to Peru, Argentina and Ghana from where it was introduced into Jamaica, Cuba and other West Indies Islands. It was introduced into India during the 1st half of the 16th century from one of the Pacific Islands of China. When it was introduced earlier from either Central America or South America. Now India along with China have half of the world's groundnut production.

- Groundnut can with stand drought and is suitable for dry land farming.
- It is producing a good green manure for succeeding crops.
- Groundnut cake is chief oil cake feed to animals and it is also used as manure.

5. SUGAR CANE PRESS MUD

Experiments were conducted in the High Ganges River Flood Plan Soils of Bangladesh to investigation to effect of press mud and inorganic nitrogen on the soil fertilizers and yield of soil production. Experiments conducted in two consecutive crop seasons comprised 8 treatment combination viz, 2 levels of press mud and three levels of N, one receives down of N, P, K, S and Zn fertilizers. The application of press mud alone increased in the cane yield by 20-30% compared to the plot receiving no pres mud. The uptake of NPK and S by the crop was lower than the added press mud.

CHEMICALS USED

1. Sulphuric acid – 93-94%
2. Potassium sulphate – 0.5g
3. Sodium carbonate – 0.1 N solution
4. O.IN Sulphuric acid
5. Boric acid – 2%
6. NaOH – Thio Mixture
7. Methyl red- methylene blue indicator

2% boric acid is prepared by dissolving 2g. boric acid in hot water and diluted to 100ml.

NaOH – Thio mixture is prepared by dissolving 50g NaOH and 5g sodium thio sulphate in hot water and diluted to 10ml.

8. 1:1 Perchloric acid – sulphuric acid mixture
9. Ammonium Vanadate solution
10. Ammonium molybdate solution.

Ammonium Vandate Solution is prepared by dissolving 2.5g. of the ammonium vanadate crystals in 500ml hot water and then 50ml. Conc. nitric acid is added and diluted to one litre.

Ammonium Malybdate solution is prepared by dissolving 50g of ammonium molybdate crystals in 500ml hot water and diluted to one litre.

11. 10% HCl

12. KCl

ANALYSIS OF MATERIALS

Chemical analysis of fertilizers is a pre-requisite to identify their composition and quality. The analysis of fertilizers is either physical or chemical. The physical analysis includes the moisture and particle size while chemical analysis include total and different forms of nutrients and impurities.

2. DETERMINATION OF MOISTURE CONTENT

Since the analysis of fertilizers is normally conducted on fresh weight basis, determination of moisture content in the fertilizer sample is critical.

The three forms of water present in fertilizers are (a) water of crystallization (b) water of absorption/adsorption and (c) free water. While the first form is integral part of a compound, the other two are interchangeable depending upon the degree of moisture saturation and temperature, etc. Methods for moisture normally adopted for different fertilizers are

(i) Oven dry method (ii) Vacuum descicator method (iii) Karl Fischer titration method and (iv) the evaporation method.

Depending upon the nature of fertilizer, different methods are utilized. The oven dry method determines total water in fertilizers but is not applicable to thermo-sensitive fertilizers which yield volatile substances other than water at drying temperature. The vacuum descicator method determines free water content of fertilizer. The Karl Fischer method determines total water in solid and liquid fertilizers. This method is quite applicable for urea, CAN, nitrophosphates and urea-based fertilizers. However, it is not applicable to phosphate rock based fertilizers due to interference of rock impurities.

2.1 Oven Dry Method

Principle

The fertilizers release free water and absorbed / adsorbed moisture on heating at varying temperatures. The method determines total water. (Fertilizer which yield volatile substances other than moisture on drying, eg: urea, CAN, DAP, nitrophosphates etc are not analysed by this method.)

Procedure

1. Weigh 2g of the ground prepared sample in clean, pre-weighed, dry weighing bottle or silica or glass petri dish.

2. Heat in an oven for about 5 hrs at 100°±1°c to a constant weight. Cool in the descicator and weigh. In case of sodium nitrate, ammonium sulphate and potassium salt, heat to constant weight at 130°c ± 1°c.

3. Report percentage loss in weight as moisture at particular temperature used.

Calculations

$$\text{Moisture \%} = \frac{100\ (B-C)}{B-A}$$

Where A→ weight of empty bottle

B→ weight of bottle with material before drying.

C→ weight of bottle with material after drying

The moisture is reported on fresh weight basis only.

3. METHOD OF NITROGEN ESTIMATION

The forms of nitrogen normally required to be determined fertilizers are (i) Total N, (ii) Ammoniacal N (iii) Ammoniacal and nitrate (iv) urea (amide) N and (v) water insoluble N.

3.1 Determination of total Nitrogen.

Total N includes all forms of inorganic N like NH_4-N, NO_3-N, Urea-N and also the organic N compounds like proteins, amino acids and other derivatives. Depending upon the form of N present in a particular sample, specific method is to be adopted for getting the total nitrogen value. While the organic N material can be converted into simple inorganic ammoniacal salts by digestion with sulphuric acid some chemical pre-treatment is required for reducing nitrates into ammoniacal form so that the end of digestion, all organic and inorganic salts are converted exclusively into ammonium sulphate form.

The Kjeldahl's digestion method for determination of total N in nitrate – free sample is described below. It is applicable to all nitrate free straight fertilizers, amm. phosphate & urea basis NP & NPK fertilizers and mixtures which are free from nitrate ions.

Principle

Organic nitrogeneous materials when digested with H_2SO_4 are oxidized to Co_2 and H_2O and their inorganic N is released. During digestion part of H_2SO_4 is reduced to SO_2 which in turn reduces nitrogenous material to ammonia. Ammonia combines with H_2SO_4 and converts into $(NH_4)_2SO_4$ at the end of digestion. The NH_3 is distilled in alkaline medium and absorbed in standard acid. The excess of unreacted acid is back titrated with standard alkali and amount of ammonia (as N) is calculated from the volume of std acid consumed.

As precision of the method depends upon complete conversion of organic N into NH_4-N in the digestion temperature and time, solid; acid ratio and the type of catalyst used have an important bearing on the method. The ideal temperature for digestion is 320-370°C. At lower temperature, the digestion may not be complete, while above 410°C, the loss of NH_3 may occur. The salt (wt:v) acid ratio should not be less than 1:1 at the end of digestion. Among various catalysts used to hasten the digestion process are K_2SO_4, Hg, HgO etc, K_2SO_4 being cheap though slightly less effective in normally used.

Procedure

Weigh out accurately 0.5g of organic sample, and place it in the long- necked kjeldahl digestion flask. Add 1 g potassium sulphate crystals, and 2.5 ml conc. H_2SO_4. Heat the flask gently in a slightly inclined position, initially at higher temperature and then digestion continued at higher temperature. After the digestion is completed, cool and make up to a 250ml standard flask (filtered if necessary), with distilled water. 10ml of this solution is pipetted out into a distillation flask and added 15 ml NaOH- thio mixture to make the mixture strongly alkaline. Take 50 ml of boric acid containing mixed indicator to a 250 ml beaker. Place the flask so that the tip of the condensor dips in the boric acid. Pass steam through the distillation apparatus until 200 ml volume is collected. Remove the beaker and titrate the distillate with 0.01 N std H_2SO_4.

Calculation

$$\%N = \frac{V x N x 250}{W} \times \frac{14.008}{10^3} \times 100$$

$$= 35.02 \times \frac{V \times N}{W}$$

Where V → volume of 0.01 N std H_2SO_4 used

N → normality of H_2SO_4

W → weight of sample taken

4. METHOD OF PHOSPHOROUS ESTIMATION

The forms of phosphates required to be analysed in different fertilizers are (i) total P_2O_5 (ii) Available P_2O_5 or Neutral ammonium-citrate soluble P_2O_5 (iii) water soluble P_2O_5 (iv) Ammonium citrate insoluble P_2O_5 and (v) citric acid soluble P_2O_5.

Determintion of total Phosphates as P_2O_5

The normally prescribed methods are analysis of total phosphates are (i) Gravimetric quinolinium phospho molybdate

(ii) Volumetric quinolinium phospho molybdate

(iii) Gravimetric ammonium phospho molybdate

(iv) Volumetric ammonium phospho molybdate and

(v) Spectrophotometric vanado phospho molybdate

4.I SPECTROPHOTOMETRIC VANADO PHOSPHO MOLYBDATE METHOD-PRINCIPLE

This method is based on the Beer-lambert's Law

The probability or rate of absorption of light by a solution is given by the Beer-. Lambert's Law.

The Beer's Law state that the intensity of a radiation absorbed by the solution is proportional to the no. of absorbing molecules ie ,the conc. of the absorbing species.

The Lambert's law states that when a beam of light is allowed to pass through a transparent medium, the rate of decrease of intensity with thickness is directly proportional to the intensity of the light.

These two laws are combined and known as Beer –Lambert's Law.

Procedure

Weigh out accurately about 2 g of organic sample into a 500 ml conical flask, add 15 ml 1:1 perchloric acid- H_2SO_4 mixture and digested on a hot plate in a controlled manner. After when the digestion is over, cool and fillered out into a 250 ml std flask. A suitable volume (5 or 10 ml) is pipetted out into a 50 ml std flask after adding 10 ml ammonium molydate solution and 10 ml ammonium vanadate solution. Then the intensity of colour is determined by spectrophotometrically. A blank is prepared without sample.

Preparation of Standard Graph

Dissolve 1.9167 g KH_2PO_4 in water and make up to 1 liter. This is 1000ppm P_2O_5. prepared 100ppm solution from this by diluting 10 ml to 100 ml. Pipetted out 1,2,3,4,5 , etc ml. This gives 2ppm, 4ppm, 6ppm, 8ppm, 10ppm , etc to 100ppm. solution into 50ml std flask containing 10 ml ammonium molydate & 10 ml ammonium vandate and dilute to the mark. Measure the optical density of the solution using spectrophotometer at 465 nm. A graph is drawn using concentration at x axis and optical density at y axis.

Calculation

% of P_2O_5 is calculated as

$$\% \ P_2O_5 = \text{conc. (graph reading)} \times \frac{250}{wt} \times \frac{50}{V} \times \frac{100}{10^6}$$

$$= 1.25 \times \frac{\text{conc.}}{W \times V}$$

where W→ weight of sample taken

V → volume of the filtrate used .

5. METHOD OF POTASSIUM ESTIMATION

Potassium in all fertilizers is found mostly in water soluble form. Methods recommented for determination of K in fertilizers are (i) volumetric sodium tetra phenyl Boron (STPB) (ii) gravimetric STPB method (iii) Gravimetric perchloric acid method (iv) Gravimetric chloroplatinate method (v) flame photometric method.

5.1 Flame Photometric Method

Procedure

2 g sample is accurately weighed out into a 250 ml beaker. Then 25 ml 10% HCl is added and heated. Then the sample is extracted with water into a 250 ml std flask, made up to the mark. If concentration is high 10ml of this is pipetted out into a 100 ml std flask and made upto the mark. The solution is aspirated in the flame & value obtained is noted.

Preparation of Standard Graph

Dissolve 1.9089 ,g kCl in water and make up to 1000ml. From this 1000ppm potassium, 100ppm potassium is prepared.

Pipette out 5, 10, 15 and 20 ml 100ppm solution into 100ml standard flask and make up to the volume. This will give 5,10,15,20ppm k respectively.

The solution is aspirated using the flame. Distilled water is used as Blank- and zero reading is adjusted by aspirating distilled water and 100 using 20ppm solution. A graph is drawn by plotting 5,10,15,20ppm ie, conc. on x axis and value obtained on y axis.

Calculation

The % if K is calculated as fallows:-

$$\% K = \text{conc.(graph reading)} \times \frac{250}{wt} \times \frac{100}{10} \times \frac{100}{10^6}$$

$$\therefore \% K_2O = \% K \times \frac{94}{78}$$

$$= \frac{0.3013 \times \text{graph reading}}{W}$$

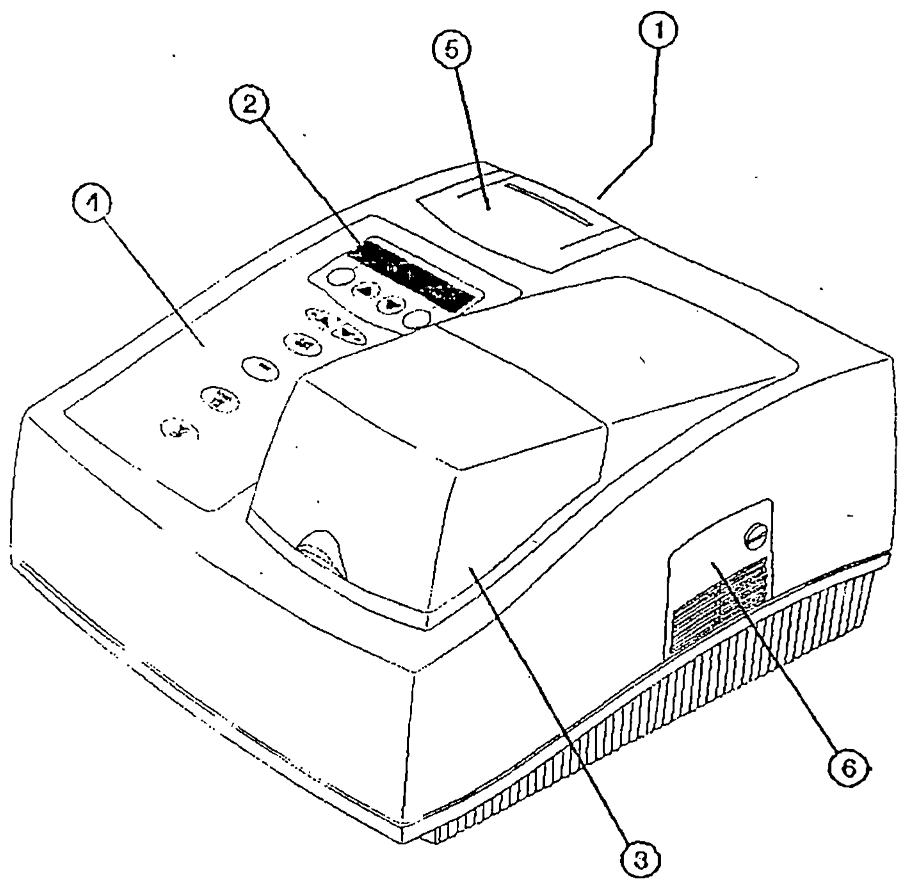
Where w → weight of sample taken

CHAPTER – 4

INSTRUMENTATION

Spectrophotometer and Flame Photometer are given by:-

SPECTRO PHOTOMETERE

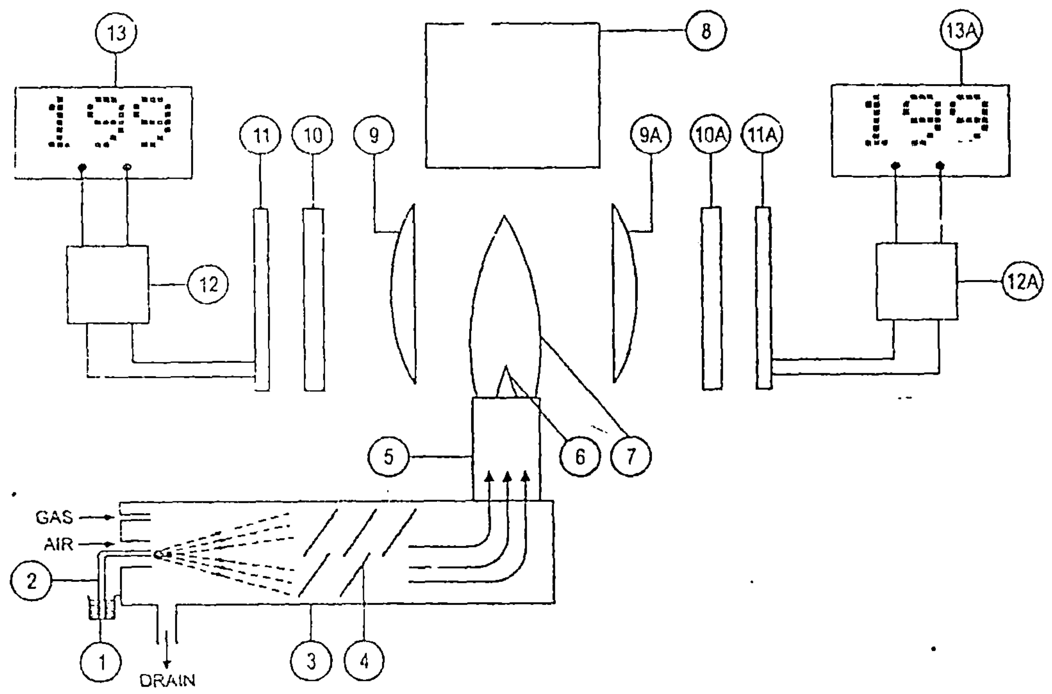


Key

1. On/off switch
2. LCD display
3. Sample compartment door
4. Keypad
5. Optional built-in printer
6. Lamp compartment door

FOTOFLAME FLAME PHOTOMETER

It is suitable for estimation of alkali metals and alkali earth metals. The equipment is normally supplied with filters for determination of Sodium and Potassium. It works on the principle that when a solution of the metallic salt is sprayed into a non-luminous flame, the flame emits light of a characteristic wavelength. The intensity of this emission is proportional to the concentration of the metal in the solution.



1.	Sample Solution	8.	Chimney top (Detachable)
2.	Atomiser intake tube	9.	Lens
3.	Mixing chamber	10.	Filter Disc
4.	Mixing vanes	10a.	Fixed Filter K
5.	Burner	11.	Photocell
6.	Inner Cones	12.	Amplifier
7.	Non-Luminous Flame	13.	Display

THEORY OF FLAME PHOTOMETRY

Principle

If solution containing a metallic salt (or some other metallic compound) is aspirated into a flame, a vapour which contains atoms of the metal will 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; for example, the characteristic yellow colour imparted of flames by compounds of sodium. This is the basic principle of FLAME EMISSION SPECTROSCOPY (FES) or FLAME PHOTOMETRY.

CHAPTER 5

RESULTS AND DISCUSSIONS

1. ESTIMATION OF NITROGEN

Some compounds are analysed for the NPK values and its results are given below:-

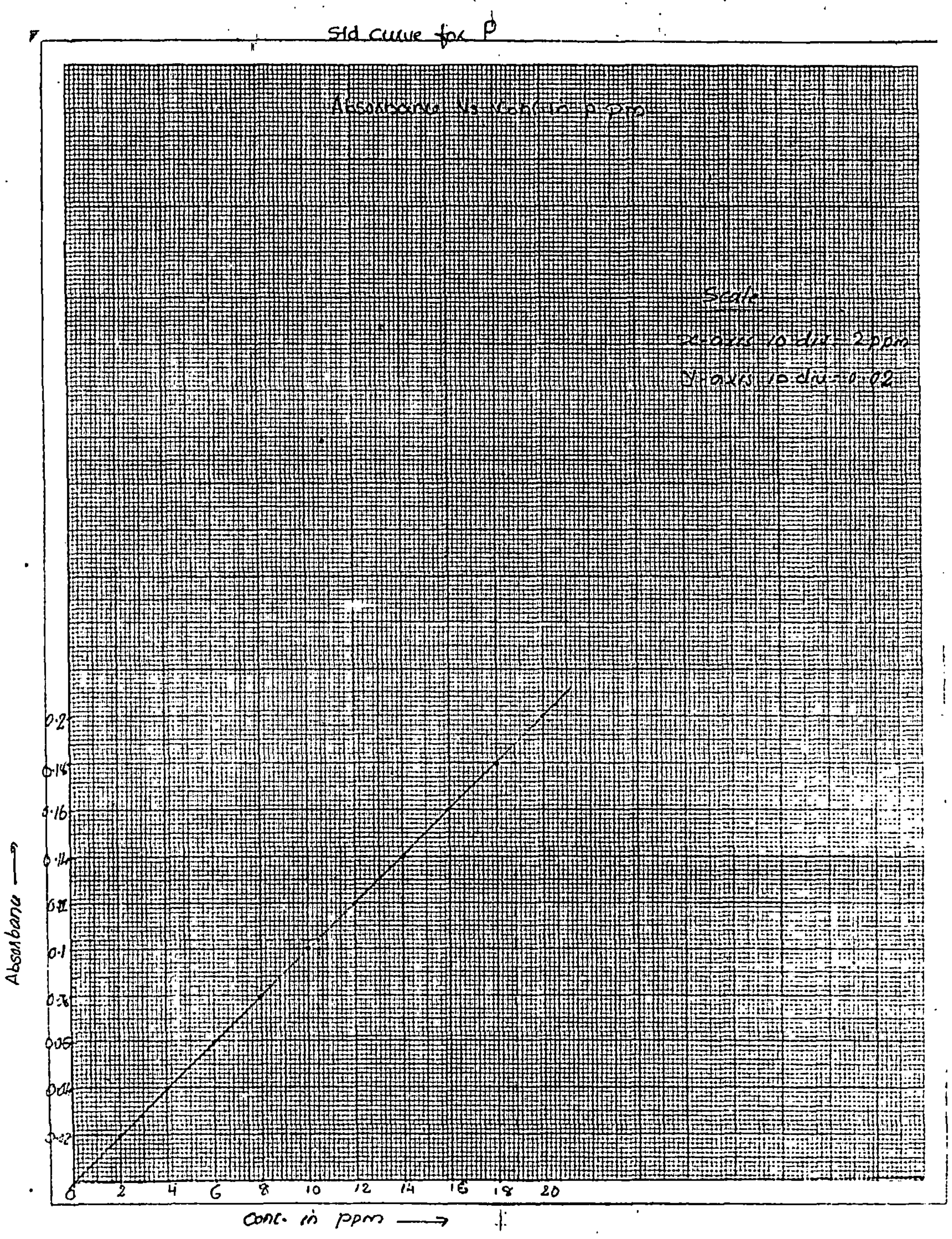
Normality of sulphuric acid used = 0.0125N

Sample	Weight taken(g)	Titration value (v) (ml)	% N= $\frac{VxNX250}{wt \times 10} \times \frac{14.008 \times 100}{10^3}$	Average value (% in ppm)
Vermi compost Sample I (a) I (b)	0.5592 0.5112	1.6 1.4	1.2525 1.1988	1.2256
Vermi compost Sample 2 (a) 2 (b)	0.5470 0.5112	1.7 1.5	1.3605 1.2888	1.325
Vermi compost Sample 3 (a) 3 (b)	0.5055 0.5010	1.4 1.3	1.2124 1.1358	1.1741
Neem cake (a) (b)	0.5070 0.5798	2 2.3	1.7268 1.7365	1.7320
Coconut cake (a) (b)	0.5730 0.5072	4.2 3.8	3.208 3.279	3.2435
Groundnut cake (a) (b)	0.5250 0.5560	7.7 7.6	6.420 5.984	6.2020
Sugarcane press mud (a) (b)	0.5919 0.519	2.4 2.4	1.775 1.775	1.775
Tea mud (a) (b)	0.5207 0.5207	4 4	3.363 3.363	3.363

2. ESTIMATION OF PHOSPHOROUS

Conc. in ppm	Absorbance
2	0.02
4	0.04
6	0.06
8	0.08
10	0.1
12	0.12
14	0.14
16	0.16
18	0.18
20	0.2

A graph is plotted with conc. as ppm in the x axis and the absorbance in the y axis. A straightline graph is obtained


Std curve for P
Absorbance Vs Conc in p ppm
Scale
X axis 10 div = 2 ppm
Y axis 10 div = 0.02
0.2
0.1
0
2
4
6
8
10
12
14
16
18
20
Conc. in ppm
Absorbance

The concentrations of Phosphorous is analysed and it is found from the standard curve. The observations are given below:-

Sample	Wt. Of sample taken (g)	Absorb-ance	Graph reading (ppm)	Volume (V)	% P_2O_5. = Conc.x $\frac{250}{wt}$ x$\frac{50}{v}$ x $\frac{100}{10^6}$	Average Value (ppm)
Vermi compost I (a)	2.0436	0.040	4.0	10	0.2446	0.252
I(b)	2.0716	0.043	4.3	10	0.259	
Vermi compost 2(a)	2.0040	0.1670	16.7	10	1.042	1.083
2(b)	2.0350	0.1830	18.3	10	1.124	
Vermi compost3(a)	2.0520	0.042	4.2	10	0.2558	0.2599
3 (b)	2.0750	0.043	4.3	10	0.2641	
Neem cake (a)	2.0057	0.036	3.6	10	0.2244	0.2215
(b)	2.0007	0.035	3.5	10	0.2186	
Coconut cake (a)	2.4121	0.105	10.5	5	1.088	1.0675
(b)	2.0297	0.085	8.5	5	1.0469	
Groundnut cake (a)	2.1281	0.088	8.8	5	1.0337	1.0424
(b)	2.1168	0.089	8.9	5	1.0511	
Sugarcane press mud (a)	2.10386	0.291	29.1	5	3.5686	3.4562
(b)	2.1233	0.284	28.4	5	3.3438	
Tea mud (a)	2.0142	0.058	5.8	10	0.3599	0.3552
(b)	2.0331	0.057	5.7	10	0.3505	

The percentage of phosphorous is calculated as P_2O_5

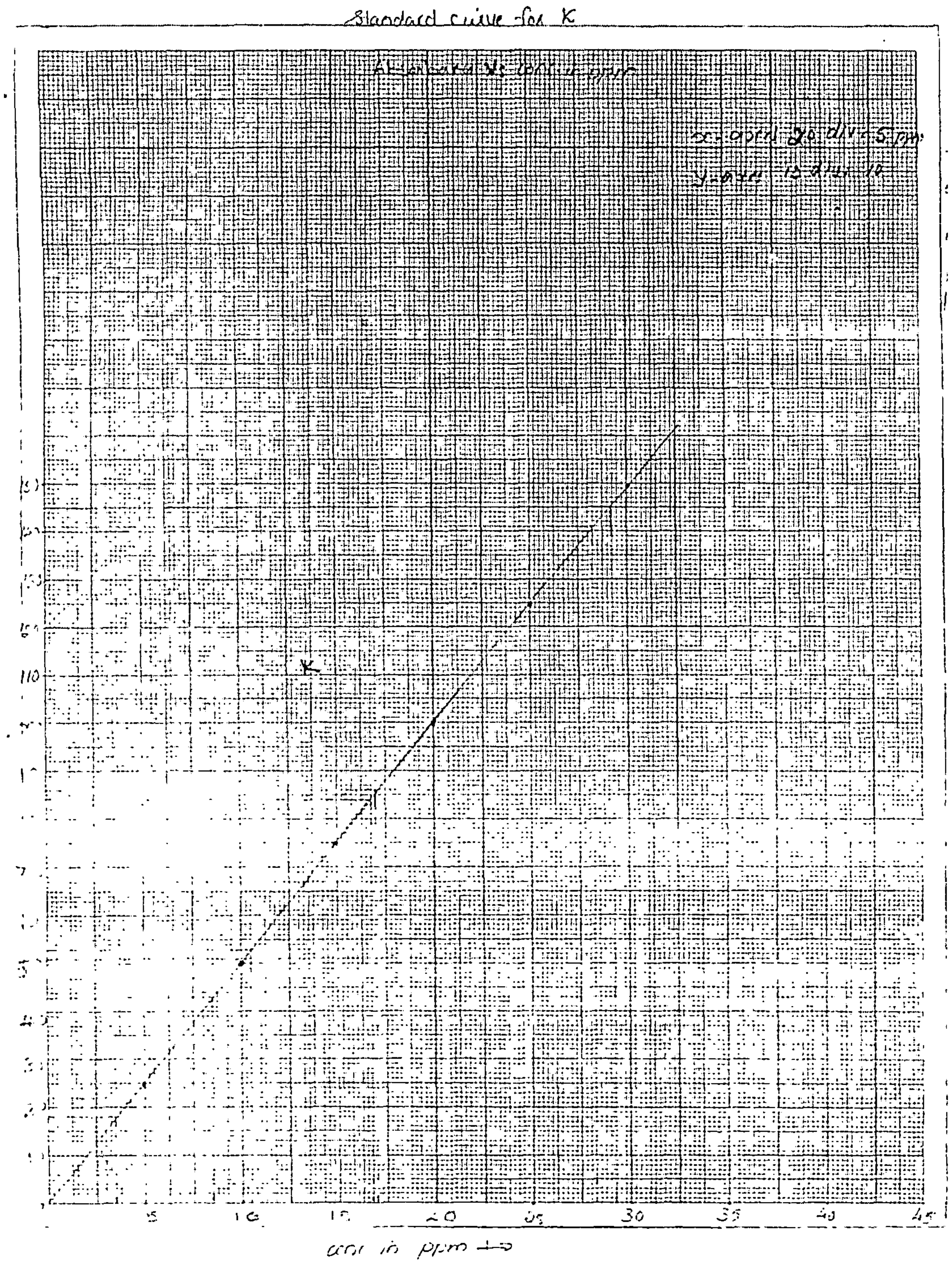
3. ESTIMATION OF POTASSIUM

A few solutions are prepared and its readings are taken from the foto flame photometer. Then a graph is plotted with photometric reading Vs conc. as ppm. Then a straightline graph is obtained. Using this graph we can determine the concentrations of unknown samples.

% of potassium is calculated in the form of K_2O.

Standard values

Cones in ppm	Spee photo flame reading
0	0
5	25
10	50
15	75
20	100
25	125
30	150


Standard curve for K
110
5
10
15
20
25
30
35
40
45
conc in ppm

Observations and calculations of K values

Sample	Wt. Of sample taken (g)	Fotometric reading	Concent-ration (ppm)	& of K2O Conc. x $\frac{250}{wt}$ x$\frac{100x100}{10\ x10^6}$ x$\frac{94}{78}$	Average Value (ppm)
Vermi compost I (a)	2.0238	18	3.5	.5210	0.5219
I(b)	2.0165	18	3.5	.5229	
Vermi compost 2(a)	2.001	43	8.5	1.2798	1.2926
2(b)	2.0195	44	8.75	1.3054	
Vermi compost3(a)	2.0002	25	5	.7532	0.7683
3 (b)	2.0155	26	5.25	.7833	
Neem cake (a)	2.0218	63	12.75	1.899	1.908
(b)	2.0426	64	13	1.9175	
Coconut cake (a)	2.1100	86	17	2.4274	2.4673
(b)	2.0128	84	16.75	2.5072	
Groundnut cake (a)	2.0567	53	10.5	1.5381	1.5335
(b)	2.0736	51	10.25	1.569	
Sugarcane press mud (a)	2.0789	141	28.25	4.3154	4.3352
(b)	2.0255	145	29.25	4.3507	
Tea mud (a)	2.0096	15	13	1.9489	1.9475
(b)	2.0125	15	13	1.9462	

% of potassium is calculated as K_2O.

CONCLUSION

Various mineral elements are necessary for the development of plant growth. All the essential nutrients are present in the soil, but some elements are not in the plant usable form. So there elements must be added to the soil in the form of fertilizer which contain one or more essential plant nutrients. The fertilizers increases the soil productivity ie, soil structure, soil bioactivity, soil exchange capacity and water holding capacity.

Various natural organic tertilizers are analysed and the results are given below:-

Sample analysied	% of N	% of P_2O_5	% of K_2O
Vermi compost sample I	1.2256	0.2520	0.5219
Vermi compost sample 2	1.325	1.083	1.2926
Vermi compost sample 3	1.1741	0.2599	0.7683
Neeam cake	1.732	0.2215	1.9080
Coconut cake	3.2435	1.0675	2.4673
Groundnut cake	6.2020	1.0424	1.5335
Sugarcane press mud	1.775	3.4562	4.3352
Tea mud	3.363	0.3552	1.9475

Three different samples of vermi compost are analysed. The values of NPK show some variations. This is because the quality of vermi compost depends on the quality of feed. Biomass with rich nutrients such as dung, poultry manure, press mud, green leaves and so on produces better quality vermi compost. When the amount of the nutrients varies the values also varies.

From the analysis it is found that the Nitrogen content is high in Groundnut cake. The phosphorus and potassium content are high in sugarcane press mud.

The importance of Neem cake is that it acts as an organic manure and pest repellent on all types of crops and soil. The NPK content of it is also very high.

Organic fertilizers have many advantages over Chemical fertilizers. The repeated usage of chemical fertilizers decreases the soil fertility and results large variations in P^H. But the use of organic and biofertilizer increases soil productivity and does not cause any harmful effect.

The above analysed organic fertilizer can directly apply to the soil and can increase the soil productivity and does not cause any harmful effect.

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