Determination of Some Characteristics of Three Selected Natural Soil Samples Collected from Chauk Township

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Abstract

The cultivated soil samples were collected from selected areas Kanphyu,Thalonethwe and Kyaungshartaw villages at Chauk Township in October, 2012.The physical properties of the soils such as color, texture, moisture and pH were determined by respective methods. The texture determination showed that the types of these three soil samples were sandy soils. The pH indicated that all three soil samples were slightly acidic but it were suitable for vegetable crop cultivations. In addition the available values of the essential elements, nitrogen, phosphorus and potassium in soil samples were measured by advanced chemical method. More over the exchangeable capacity of the secondary soil nutrients (calcium, magnesium, potassium) and the bulk density, the organic carbon content and humus were also determined by respective methods.

Keyword: pH, texture nutrients

Introduction

As important factor influencing the productivity of our planet's various ecosystems is the nature of their soils. Soils are vital for the existence of many forms of life and provide plants with a medium for growth and supply these organisms with most of their nutritional requirements. The formation of a soil is influenced by organisms, climate, topography, parent material, and time. Still soils are the basis for 90% of human food, livestock feed, fiber, and fuel. Soils hold nutrients and water for plants and animals. The foods and the materials are dependent on soils. A good soil for growing agricultural plants has about 45%mineral, 5%organic matter, 25% air and 25% water. All crops need the same kind of elements in addition to water air, but plants differ in the relative amounts of their requirements of these essentials. They are known as fertilizer elements such as potassium, nitrogen, phosphorus, hydrogen, carbon, and oxygen. Some elements necessary in small amounts of soils are iron, zinc, copper and manganese. But some elements in soil are toxic to plants such as selenium, arsenic, fluorine, aluminum and nickel. Today, scientists, famers, and other professionals consider a soil's physical and chemical characteristics, moisture content and temperature to make decision such as "what types of crops will grow best in a particular field?" Groundnut, sesame, beans and other crops have been cultivated in Chauk Township. Therefore the soil samples were collected from Kanphyu, Thalonethwe, and Kyaungshartaw villages at Chauk Township to study the physical properties and investigate quantitatively the chemical constituents.

Materials and Methods

Preparation of Soil Samples

Sample Collection

The soil samples which were collected from Kanphyu, Thalonethwe and Kyaungshartaw villages situated in Chauk Township for this research work. The soil samples which were dug the depth of 18 cm from the earth surface in the study areas were put in thick plastic bags, labeled suitably both outside and inside the bags and brought to laboratory.

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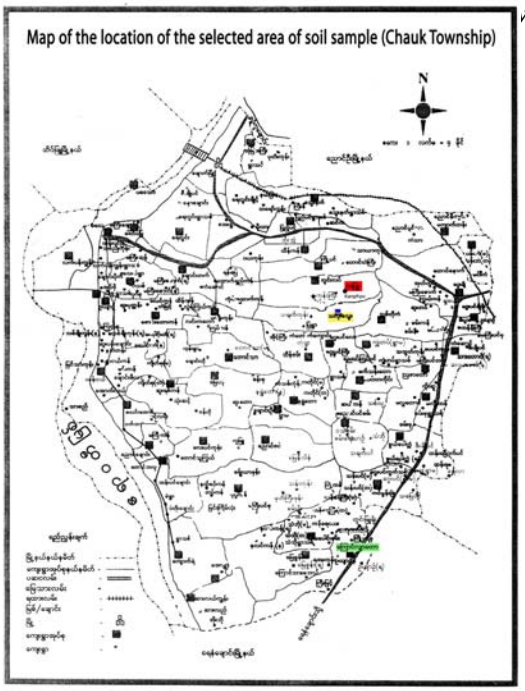

Figure (1). Map of the location of the selected area of soil samples.

Drying of Soils

At the laboratory, the soil samples were emptied from their bags and spread out on paper sheets. The soil samples were allowed to dry in air.

Grinding and Sieving

Stones and pieces of macro organic matter were picked out and the remainders were crushed into fine powder. Large lumps were broken up by hand and then the soils were ground. After grinding, the soils were screened by 2 mm sieve. Soil remaining on the sieve which is greater than 2 mm was not used to analyse.

Storage of Soil Samples

The soil samples were stored in screwed capped glass jars and labeled them properly as sample 1, sample 2 and sample 3.

Determination of Moisture Content

Principle

The sample is allowed to dry in an electric oven at 105°C for about eight hours. After cooling in desiccator and weighed. Heating, cooling and weighing were carried out until constant weight was reached. From the loss in weight, the percentage of moisture of the sample was calculated.

Apparatus

1. Electric oven
2. Desiccator
3. Analytical balance (200 g capacity capable of weighing up to 0.1 g)
4. Porcelain basin

Procedure

Accurate weights of porcelain basins were first determined. Then about 2 g each of soil samples were placed in basin separately and weighed accurately. They were allowed to dry in electric oven at 105°C, followed by cooled in desiccator to get constant weight. The moisture contents of soil sample 1, 2 and 3 are shown in Table 1.

Determination of Soil pH

Theory

Soil pH is the most widely measured soil parameter. This pH measurement determines the degree of acidity or alkalinity in soil materials suspended in water. It influences a large number of environmental mechanisms such as leaching of nutrients from soil; the provision of nutrients and water to plant. It is not possible to measure the pH of a dry soil and we need to add water to soil prior to pH determination. It is not easy to decide how much water to add to soil.

Apparatus

Balance,accurate ± 0.1 g, pH meter.

Reagents

pH 4.0 buffer solution, pH 10 buffer solution, distilled deionized water

Procedure

About 20 g of sample was weighed accurately and placed into a conical flask and 50 cm^3 of distilled water (pH - 7) was added (the ratio of sample to water was 1:2.5) and shaken for half an hour. The clear solution was decanted. Then pH was measured by pH meter using glass electrode. The pH meter was standarized with buffer solution before use. The pH values of soil sample 1, 2 and 3 are shown in Table 1.

Determination of Texture by Pipette Method

Reagent

10 % of sodium pyrophosphate solution

Procedure

About 10 g of sample was weighed accurately and placed in a 500 cm^3 conical flask and some amount of distilled water was added. The flask was heated till boiling 10 cm^3 of 10 % sodium pyrophosphate solution was added to disperse the soil colloids and heating was continued for about 15 minutes. Then it was cooled. After cooling, the contents were transferred to a 1000 cm^3 graduated cylinder and the solution was made up to the mark with distilled water and then kept overnight to allow the soil colloids to settle.

The next day, the contents were stirred for about four minutes; the solution from 9 cm depth was pipetted with 25 cm^3 pipette into a porcelain basin and evaporated. From this residue, the percentage of clay and silt was calculated. After four hours of the stirring, the solution was pipetted with 25 cm^3 pipette from 4 cm depth and evaporated. From this residue, the percentage of clay was calculated. Then the percentage of silt was obtained by difference. To determine the amount of sand, the remaining solution was poured into 50 μm sieve and the clay and silt were washed with water. The sand, silt and clay percentages of these three soil sample 1, 2 and 3 are shown in Table 1.

Determination of Bulk density

Principle

Bulk density of a soil can be calculated from their mass and volume.

Apparatus : weighing bottle, Burette (50 mL)

Procedure

Bulk density of a soil can be calculated from their mass and volume. A dry, clean weighing bottle was weighed. A little dried soil sample was added into the weighing bottle to compress by knocking it on the table. After several times of adding soil sample, it was full of soil sample in the weighing bottle. Then, the surface of soil sample at the top the weighing bottle was leveled off by use of specula or glass rod and weighted it. The soil sample was removed from weighing bottle and it was cleaned with a piece of cotton or clothes. The weighing bottle was filled with boiled, cooled, distilled water and the volume of water added were recorded. By using the mass of the soil samples and volume of water added, the bulk density of soil sample was calculated. The bulk density of soil sample 1, 2 and 3 is shown in Table 1.

Determination of Organic Carbon and Humus by Walkey and Black's Titration Method

Principle

A suitable quantity of the sample is digested with chromic and sulphuric acids, making use of the heat of dilution of sulphuric acid. The excess of chromic acid left over unreduced by the organic matter of the soil is determined by a titration with standard ferrous solution using 0.2 % phenylanthranilic acid as an internal indicator.

Apparatus

Conical flask 100 cm^3, 10 cm^3 pipette, 50 cm^3 burette

Reagents

0.4 N chromic acid, 0.2 % Phenylanthranilic acid, 0.4 N Mohr's Solution

Procedure

About 0.4 g of fine soil sample was weighed accurately and put in a clean dry conical flask. 10 cm^3 of 0.4 N chromic acid solutions was poured and stirred carefully. Then a small funnel was inserted in the flask and heated on a hot plate to boil gently. After boiling, the funnel and the neck of the flask was washed with distilled water. About 5 drops of 0.2 % phenylanthranilic acid solution was added and titration was done with 0.4 N Mohr's solution till the content turned in green color. Amounts of organic carbon for these three soil sample 1, 2 and 3 are shown in Table 1.

Determination of Nitrogen Content

Principle

The nitrogen in the sample is converted to ammonium (NH_4^+) by digestion with concentrated H_2SO_4 in the presence of salicylic acid and a catalyst mixture. NH_3 is determined after steam distillation by capture in an excess boric acid on titration with HCl.

Reagents

Sulfuric acid-Salicylic acid mixture, $Na_2S_2O_3$, 30 % NaOH, indicator, boric acid indicator mixture and catalyst selenium mixture.

Procedure

Treat exactly 100 g of dried sample in a 200 mL kjeldahl digestion flask with 7 mL sulfuric acid-salicylic acid mixture. After 30 minutes, 0.5 g of $Na_2S_2O_3$ was added and shaken. Wait 15 minutes and 3 mL of H_2SO_4 and about 200 mg catalyst mixture were added. Heat the flask on a digestion rack until the solution turns clear. After cooling, 30ml of H_2O, alkalize the solution with 30ml of 30% NaOH and start the steam distillation immediately, taking care that the glass receiver tube was immersed into the collecting solution. The distillate into a 100ml Erlenmeyer flask containing 10ml boric acid indicator mixture was collected. After distillation of all NH_3, the boric acid solution was titrated with 0.01N HCL. At the end point, the indicator turns green to red. The available nitrogen contents of three soil sample 1, 2 and 3 are shown in Table 1.

Determination of Available Phosphorus by Truog's Method

Reagents

Ammonium sulphate and sulpuric acid buffer solution (pH = 3), 2.5 % ammonium molybdate solution, Chlorostannous acid solution, Standard phosphate solution

Procedure

About 2 g of sample was weighed accurately and placed into shaking bottle. 400 cm^3 of ammonium sulphate and sulphuric acid buffer solution (pH = 3) was added and the bottle was shaken for half an hour. After that, it was filtered, 50 cm^3 of filtrate was pipetted into 100 cm^3 volumetric flask. Then 4 cm^3 of 2.5 % ammonium molybdate solution was added. This was followed by the addition of 6 drops of freshly prepared chlorostannous acid and made up to the mark with distilled water. Within 15 minutes after adding the chlorostannous acid to the filtrate, the intensity of color was measured at wavelength 660 nm by using spectrophotometer. Amounts of available phosphorus for soil samples were shown in Table 1.

Determination of Available Potassium by Flame Photometer

Reagents

1N ammonium acetate solution

Procedure

About 5 g of sample was weighed accurately and placed in a 100 cm^3 shaking bottle containing 50 cm^3 of 1 N ammonium acetate solution. The bottle was shaken for one hour and the solution was filtered. The amounts of potassium and sodium in the filtrate were measured by using the fame photometer.

Determination of Exchangeable Calcium and Magnesium

Reagents

1N sodium chloride solution, 0.02 N EDTA solution, ammonium buffer solution (pH = 10), 10 % sodium hydroxide solution, Eriochrome Black T indicator, murexide indicator

Procedure

About 2.5 g of sample was weighed accurately and placed in a 500 cm^3 shaking bottle containing 250 cm^3 of 1 N sodium chloride solution. The bottle was shaken for three minutes and kept overnight and then filtered.

To determine calcium and magnesium, 25 cm^3 of filtrate was pipetted into conical flask and then 5 cm^3 of ammonium buffer solution (pH = 10) was added. Eriochrome.. Black T was used as an indicator. It was titrated with 0.02 N EDTA solutions until the color changed to blue.

To determine calcium, 25 cm^3 of filtrate was pipetted into conical flask and then 2 cm^3 of 10 % sodium hydroxide solution was added. Murexide was used as an indicator. It was titrated with 0.02 N EDTA solutions and the end point color was violet. The amount of calcium and magnesium for three samples is shown in Table 1.

Results and Discussion

The selected soil samples contain nearly 95% of sand. Therefore these are sandy soil to grow any kind of crops. The physical properties of soil such as moisture, texture, and bulk density were determined. The pH determination indicates that all three soil samples were slightly acidic but it was suitable for vegetable crop cultivation because most of agricultural soil has the pH range between 4 and 8.5. The macronutrients such as N, P, K were measured by advanced chemical methods. The abundant macronutrient content was found to be in soil sample 2. The texture determination shows that the types of these three soil samples were sandy soils. Thus, the moisture contents and the organic carbon contents were found to be very low but higher values of bulk density. The exchangeable calcium and magnesium were found to be moderate. The exchangeable of calcium and magnesium were sufficient in the selected soil samples. There were very low concentration of phosphorus and potassium in soil sample 1 and 3. It should be repaired soil fertility by addition of natural fertilizer such as manure, humus or/and animal dung with wood ash and bone ash.

Table (1). Results of the Determination of Selected Soil Samples.

	Description	Result		
		Sample 1	Sample 2	Sample 3
1.	Moisture %	8.78	11.02	3.85
2.	pH	5.91	5.85	6.28
3,	Bulk density	3.37	2.47	3.28
4.	Total nitrogen%	0.053	0.071	0.035
5.	Available P_2O_5 ppm	3.43	28.97	12.32
6.	Avaliable K_2O ppm	5.41	10.32	4.80
7.	Exchangeable Ca meq/100g	5.32	4.66	3.996
8.	Exchangeable Mg meq/100g	1.33	1.33	1.33
9.	Exchangeable K meq/100g	0.115	0.22	0.102
10.	Humus%	0.134	0.134	0.0202
11.	Organic Carbon%	0.078	0.078	0.117
	Sand %	95	95	95
	Silt %	4	3	5
	Clay %	1	2	2
	Textural Type	Sandy	Sandy	Sandy

Sample 1 = which is collected from Kanphyu in ground field
Sample 2 = which is collected from Thalonethwe in pigeon field
Sample 3 = which is collected from Kyaungshartaw in sesame field

Conclusion

In this research work, the moisture content, pH and the texture of the three selected soil samples were determined as physical properties. Moreover the available values of N, P, K, organic carbon content will also be investigated. In addition, the bulk density, humus percent and the amount of exchangeable cation (K^+, Ca^{2+}, Mg^{2+}) of the selected soil samples were determined. According to the experimental results, the mineral content of soil sample 2 was greater than 1 and 3. It can be noted that the quantity of soil sample becomes promoted by cultivation of bean plants as well as addition of natural fertilizers with wood ash.

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