Analysis of Physicochemical Properties of Soil Samples from Taohn Village in Shwebo Township, Sagaing Region

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Abstract

In this research paper, the soil samples were collected from three different places of Taohn Village, Shwebo Township, Sagaing Region. Sample (1) denoted by S_1 was collected from south of Village, sample (2) denoted by S_2 was collected from east of the Village and sample (3) denoted by S_3 was collected from north of Village. The soil samples were taken from 10" depth to get untreated condition. Physical properties of these samples such as moisture, pH, electrical conductivity and soil texture were determined. The elemental compositions of soil samples were determined by WDXRF method. The highest value of silicon was observed in all samples. Moreover, the major nutrients such as total nitrogen, available phosphorus and potassium were assigned. The total nitrogen contents in selected samples were determined by Kjeldahl's Titration method. The potassium content in selected samples were analysed by flame photometric method. The phosphorus contents in selected samples were determined by UV-vis spectrophotometric method. The minor nutrients such as exchangeable calcium, magnesium, sodium and potassium and water soluble salts such as carbonate, bicarbonate, chloride and sulphate were measured by conventional methods.

***Keywords*:** Soil samples, Kjeldahl's, UV-vis spectrophotometric method, water soluble salts, WDXRF method

Introduction

Soil is referred to as earth or dirt, is a mixture of organic matter, minerals, gases, liquids and organisms that together support life. Soil is an important component of environmental chemical cycle. Soils vary greatly from one location to another. A soil analysis is used to determine the level of nutrients found in a soil sample (Voroney *et al*.,2007).

Soil is a product of several factors the influence of climate, relief, organisms and soil' parent materials interacting over time. Special attention should be paid to physical and the chemical analysis of soil (Gilluly *et al*., 1975).

Soil is classified into four types: sandy soil, silt soil, clay soil and loamy soil. Alkali or alkaline soils are clay soils with high pH (greater than 8.5). Alkali soils owe their unfavorable physico-chemical properties mainly to the dominating presence of sodium carbonate which causes the soil to swell and difficult to settle.The soil samples are called natural soda. It is an impure efflorescent deposit containing salt of sodium including the carbonate with a large amount of intermixed sand. It is used for cleaning and washing (Emteryd, 1989). In this research work, soil samples were collected from Taohn Village, Shwebo Township, Sagaing Region to determine chemical analysis.

Materials and Methods

Collection of Soil Samples

Three types of soil samples were collected from 10 inches depth from the selected area. Soil samples were taken from Taohn Village, Shwebo Township, Sagaing Region.

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Sample (1) Sample (2) Sample (3)

Figure 1. Soil Samples (1), (2) and (3)

Preparation of Soil Samples

The collected sample may be kept in drill bags, and labeled suitably. When the samples are received at the laboratory, it should be broken up and spread them on shout sheets of brown paper for air dried. When the samples are air dried, the samples are ground in a mortar with a pestle. The soil should be sieved through a sieve with 250 meshes. The passing the sieve were used for subsequent analysis (Mangosongo *et al*.,2019).

Estimation of Soil pH

Sample (25 g) was weighed accurately and placed into a conical flask. Then 50 mL of de-ionized water was added and shaken for half an hour. The pH was measured by pH meter. The pH meter was calibrated with pH 4.0 and pH 10.0 buffer solution before use (Mclean, 1982).

Determination of Moisture

Constant weight of the weighing bottle was first determined. Then about 5 g of soil sample was transferred into weighing bottle and weighing accurately. It was allowed to dry in electric oven at 105°C. Then it was dried to constant weight.

Estimation of Electrical Conductivity (EC)

Sample (10 g) was weighed and 50 mL of distilled water was added to make a 1 : 5 w/v soil water suspension solution. Then it was allowed to stand for an hour. Conductivity meter was calibrated using 0.01 M KCl solution. Soil solution was filtered and electrical conductivity of filtrate was determined by conductivity meter

Estimation of Texture

About 10 g of air-dry soil was weighed accurately and placed in a 500 mL conical flask and some amount of distilled water was added. The flask was heated till boiling. 10 mL of 10 % sodium pyrophosphate solution was added to disperse the soil colloids and heating was continued for about fifteen minutes after which it was cooled. After cooling, the contents were transferred to a 1000 mL 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 pipette with 25 mL pipette and then it was transferred to a porcelain basin and evaporated on a water bath. From the weighted amount of residue, the percentage of clay and silt were calculated. After four hours of the stirring, the solution was pipette with 25 mL pipette from 4 cm depth and evaporated to dryness. 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 250 mesh sieve and the clay and silt were washed with water. The percentage of sand was calculated.

Evaluation of Exchangeable Sodium and Potassium

The amounts of exchangeable sodium and potassium in the filtrate were measured by using the flame photometer.

Estimation of Exchangeable Calcium and Magnesium Ions

The presence of exchangeable calcium and magnesium ions in extracted samples were determined by EDTA titration method using calcon as an indicator.

Determination of Elemental Contents

The elemental contents of soil samples were analyzed by Wavelength Dispersive X-Rays Fluorescence (WDXRF) at Department of Chemistry, Yadanabon University.

Estimation of Nitrogen

Air-dry soil (2 g) was weighted accurately and placed in a dry clean Kjeldahl's flask. 1-2 g of catalyst and 3-5 mL of concentrated sulphuric acid was poured stirred and the flask placed on a heater in the fume chamber and heated gradually. The boiling of the sulphuric acid in Kjeldahl's flask should be gentle, for vigorous boiling could cause loss of the nitrogen due to the partial decomposition of ammonium sulphate.

When the digestion was over, the Kjeldahl's flask was cooled and the internal wall and neck of the flask was washed with distilled water. The diluted solution was transferred into the distillation flask. The Kjeldahl's flask was rinsed with distilled water and again, the washing liquid was added to the distillation flask. A receiver was filled with 10 mL of 2% boric acid and placed under the tube of condenser. After pouring the alkali solution into the flask, the steam distillation was started. The solution was heated for at least twenty minutes to distill of ammonia and titrated with 0.05 M HCl solutions using the methyl orange indicator until solution turned to red.

Determination of Available Phosphorus and Potassium

The amount of available phosphorus and potassium from the soil samples were measured by UV-vis spectrophotometric method.

Determination of Water Soluble Salts in Soil

Preparation of Soil Water Extract Solution

Air-dry soil 100 g and 500 mL of distilled water (1:5 w/v) in a 1 liter of conical flask was shaken vigorously for three minutes and filtered. The water soluble salts carbonate, bicarbonate, chloride and sulphate ions were measured from the filtrate.

Estimation of Carbonate, Bicarbonate and Chloride Ions

Filtrate 25 mL was pipette into the 250 mL conical flask and 1-2 drops of phenolphthalein indicator was added. If the solution was colorless there was no carbonate in the soil, but if it turned pink, carbonate was present and titration was done with 0.02 M H_2SO_4 until the pink color disappeared. After the titration for carbonate 2-3 drops of methyl orange indicator was added to the same solution to determine the bicarbonates. The solution was titrated with 0.01 M H_2SO_4 until the color changed to orange. For the determination of chloride, 1 mL of 10 % potassium chromate was added to the above conical flask and titrated with 0.02 M $AgNO_3$ solutions. The color of the end point was reddish brown.

Determination of Sulphate Ion

Extract solution 25 mL was pipette and a piece of Congo red paper was put into the 250 mL conical flask. 10 % hydrochloride acid solution was dropped till the Congo red paper turned to blue and the solution was treated to boil. 5 mL of 0.02 M $BaCl_2$ solutions was added and it was cooled to room temperature. After the solution was neutralized with 10 % ammonium hydroxide solution (the Congo red turned to red) 5 mL of magnesium chloride solution and 5 mL of buffer solution (pH = 10)

were added. Titrated with 0.02 M EDTA solution using EBT as an indicator until the color greenish blue appeared.

Results And Discussion

Physicochemical Analysis of Soil Sample

The extracted samples were analyzed by some physical and chemical properties. The data of all samples were showed in Table 1, 2, 3 and 4.

Table 1. Some Physical Properties of Soil Samples

Sample	pH	Moisture (%)	EC (mS/cm)
S_1	10.48	3.61	1.30
S_2	10.77	0.95	0.76
S_3	10.78	0.75	0.87

According to Table 1, the pH values of samples are greater than 10. So, the soil samples are strongly alkaline. Moisture content of sample-1 is larger than the other two. Soil moisture content may be prevented excess irrigation and leaching of nutrients. Soil sample-1 is also larger electrical conductivity, than the soil sample-2 and -3. Therefore, sample -1 contained the higher amount of dissolved materials.

Table 2. Textural Analysis of Soil Samples

Samples	Composition			
	Sand (%)	Silt (%)	Clay (%)	Texture
S_1	85.98	8.74	10.28	Sandy Soil
S_2	87.98	15.74	9.28	Sandy Soil
S_3	89.98	7.74	8.28	Sandy Soil

In Table 2, high sand percent were present in all soil samples. These samples are sandy soil. According to the results, these soil samples do not maintain the water for a long time.

Table 3. The Results of Exchangeable Cations Analysis of Soil Samples

Sample	Exchangeable Cations (meq/100 g)				Remark			
	Na^+	K^+	Ca^{2+}	Mg^{2+}	Na^+	K^+	Ca^{2+}	Mg^{2+}
S_1	29.95	0.12	10.38	4.15	Very High	Low	Medium	Medium
S_2	11.19	0.09	30.29	2.02	Very High	Very Low	High	Low
S_3	11.18	0.08	16.12	2.02	Very High	Very Low	Medium	Low

According to Table 3, high values of exchangeable sodium cations are found in these soil samples. As a result, seedling germination and plant growth are

problematic and the highest amount of exchangeable calcium ions are present in soil sample-2.

Table 4. The Results of Elemental Contents of Soil Samples by WDXRF Method

No.	Element	Relative Abundance (%)		
		S_1	S_2	S_3
1.	Silicon	56.60	55.40	63.10
2.	Aluminium	17.50	10.80	11.30
3.	Iron	13.60	5.98	5.80
4.	Calcium	5.07	19.80	10.60
5.	Potassium	4.34	4.96	6.06
6.	Titanium	0.97	0.87	1.31
7.	Sulphur	0.13	0.03	0.00

According to these results, the highest amount of silicon and the lowest amount of sulphur contain in all samples. Therefore, these sample were inductively that as a sandy soil.

Table 5. The Results of Essential Elements (N P K) Contents for Plant

Sample	Essential Elements			Remark		
	Total N (%)	Available P_2O_5 (ppm)	Available K_2O (mg/100)	Total N (%)	Available P_2O_5 (ppm)	Available K_2O (mg/100)
S_1	0.11	1.09	5.60	Low	Low	Low
S_2	0.10	0.10	4.24	Low	Low	Low
S_3	0.12	1.14	3.63	Low	Low	Low

Table 5 shows essential element (N P K) contents for plant. From the result, the contents of essential elements (N P K) were low in all samples. So, these soils cannot be used in agricultural land.

Table 6. Water Soluble Cations and Anions in Soil Water Extract

Sample	Anions (meq/100 g)				Cations (meq/100 g)			
	CO_3^{2-}	HCO_3^-	Cl^-	SO_4^{2-}	Ca^{2+}	Mg^{2+}	K^+	Na^+
S_1	0.92	2.31	0.60	1.01	0.14	0.10	0.01	5.54
S_2	1.06	3.10	0.28	0.22	0.77	0.24	0.53	4.11
S_3	1.45	2.24	0.32	0.52	0.29	0.14	0.03	4.63

Table 6 represents water soluble cations and anions in soil water extract. According to this result, in soil samples-1, 2 and 3, the value of HCO_3^- ions are higher than the other anions such as CO_3^{2-} , Cl^- and SO_4^{2-} . In all soil sample, the amount of Na^+ ions are larger than that of Ca^{2+}, Mg^{2+} and K^+. High levels of bicarbonates pull calcium out of solution, reducing the presence of calcium on soil exchange sites, hydroxides ions (OH^-) in water. Alkaline compounds in water remove H^+ ions and increase pH.

Conclusion

The soil samples were collected from Taohn Village, Shwebo Township, Sagaing Region. They were taken from three different places as sample 1, 2 and 3.

These samples were analyzed for physical and chemical properties. From the results, the value of moisture content in sample 1 was 3.61 %, sample 2 was 0.95 % and sample 3 was 0.75 %. The pH values were greater than 10. So, the soil samples are strongly alkaline.

The values of electrical conductivity were 1.30, 0.76 and 0.87 mS/cm respectively. Among them, sample (1) has highest value of 1.30 mS/cm. It may due to the increase of total dissolved salt. The type of soil samples was also determined by texture percent. It was found that all samples were sandy soil. The exchangeable sodium contents were very high in all samples 29.95, 11.19 and 11.18 meq/100 g. The exchangeable calcium contents were found to be 10.38, 30.29, and 16.12 meq/100 g. From WDXRF result, the highest amount of silicon and the lowest amount of sulphur contain in all samples.

The major nutrients contents were found to be range of 0.1-0.2 % for total nitrogen (< 5 ppm) for available phosphorus (< 10 mg/100 g) for available potassium respectively. So, the major nutrients were low in all samples. From water soluble cations and anions in soil water extract data, higher amount of sodium ions and bicarbonate ions were observed for all samples. According to these results, samples may be regarded as alkaline soil. Due to the low content of major nutrients and highest ions of sodium and bicarbonate the selected soil samples were not applicable for agricultural purpose. So, it may be required special remedial measurement and management practices for agricultural purpose. These are suitable for used as raw material in soap industrial.

Acknowledgments

We would like to express our deepest gratitude to Dr Myo Myo, Rector, Dr Tin Tin Yi, Pro-rector, Shwebo University for their interest and encouragement on our research paper. We also which to express our thanks to Dr Thi Thi Aung, Professor and Head and Dr Mya Theingi, Professor, Department of Chemistry, Shwebo University for their suggestion and invaluable guidance for this research work.

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