Study on the Characteristics of Paddy Field Soil Samples from Two Villages, Amarapura Township, Mandalay Region

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Abstract

Rice is the most important staple food for a large part of the world's human population. In Myanmar, rice is the main source of carbohydrate and is cultivated in every part of country. In this study, the two soil samples were collected from Daung-yway village (sample1) and Sauk-taw-wa village (sample2) in Amarapura Township, Mandalay Region, Myanmar. The soil samples were tested to determine pH, moisture and other characteristics such as the organic matter and soil texture. The pH and moisture content of soil sample 1 and 2 were found to be 7.4 and 7.9, 7.93% and 5.76%. These soil samples were slightly alkaline. According to the content of sand, silt and clay, the soil textural class for both soil samples was found to be clay. The two soil samples were light brown color. Organic matter contents of two soil samples were1.62% and 1.74%. Then major nutrients of soil, N, P, K values were also tested. The status of available nitrogen was determined by alkaline permanganate method. Available phosphorus was examined by Olsen's method. 1N Ammonium acetate extraction method was used to investigate the soil available potassium. The N, P, K contents of soil sample 1 and 2were found to be 76mg/kg nitrogen and 14mg/kg phosphorus, 205mg/kg and 213mg/kg potassium respectively. In addition, the exchangeable cation analysis was done and sodium adsorptive ratio (SAR) of both soil samples was found. The elemental compositions in soil samples were performed by Energy Dispersive X-ray Fluorescence (EDXRF) techniques. The elemental contents such as Si, Fe, K and Ca were found to be 41.136% and 35.185% Si, 38.425% and 35.935% Fe, 11.144% and 7.937%K, 4.710% and 16.603% Ca, respectively.

Keywords: Soil texture, Soil parameters, NPK, EDXRF

Introduction

Soils are made up of four basic components: minerals, air, water and organic matter. In most soils, minerals represent around 45% of the total volume, water and air about 25% each, and from 2% to 5% organic matter. The mineral portion consists of three distinct particle size classified as sand, silt or clay. Soil supply plants with mineral nutrients. A fertile soil will provide a continuing supply of dissolved mineral nutrients in amount of relative proportions appropriate from optimal plant growth (Driessen *et al.,* 2001). Soil is made up of many things like weathered rock particles, plant and animal matter. Soil is a complex, unconsolidated mixture of inorganic, organic and living material that is found on the immediate surface of the earth that supports plant life. Soil is so important to us. Without soil, there would be no plant life on the surface of the land. (Nyle C. Brady., 1974).

Another soil characteristic is "soil structure". It is distinct from soil texture. Structure refers to the clumping together or aggregation of sand, slit and clay particulars into lager secondary clusters. Soil structure is developed through the action of soil biota such as microbes and earthworms. Good soil structure is apparent when the soil crumbles easily. This is an indication that the sand, silt, and clay particles are aggregated into granules or crumbs. Soil that contains no living organisms will become degraded as leaves cannot decompose and are left to pile up on the soil surface. They will not decompose and form the nutrients that

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plants need. Thus soil is the vital resources that must be preserved to support farming sustainability (FAO. 1998).

Other soil characteristics are soil pH and mineral nutrients. Soil pH is a measure of the acidity or alkalinity of a soil. The thirteen mineral nutrients which come from the soil are dissolved in water and absorbed through a plant root. The mineral nutrients are divided into two groups, macronutrients and micronutrients. Macronutrients can be broken into two or more groups primary and secondary nutrients. The primary nutrients are nitrogen, phosphorus and potassium. These major nutrients are lacking from the soil first because plants used large amount of for their growth and survival. The secondary nutrients are calcium, magnesium and sulphur. There are usually enough of these nutrients in the soil so fertilization is not always needed (Gupta, 2000). The plant is the source of plant nutrients. Plants absorb their mineral nutrients from the soil in the form of dissolved salts. Therefore, soil samples from two villages, Daung-yway and Sauk-taw-wa, Amarapura Township, Mandalay Region, were chosen to study in this research.

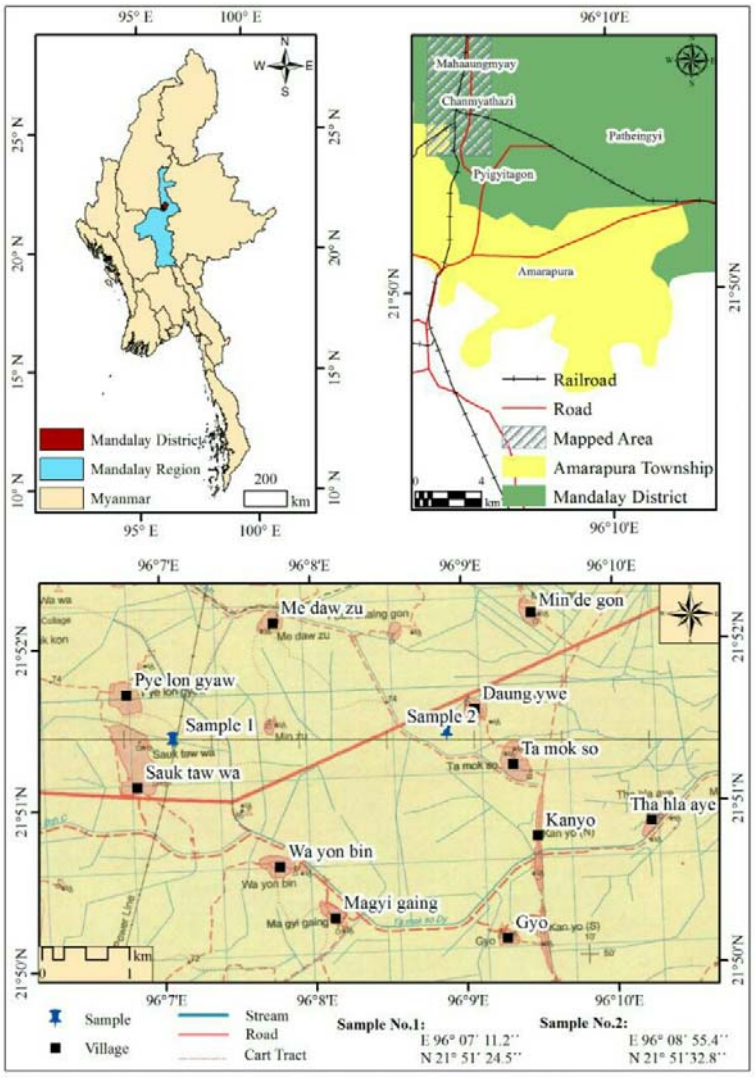

Figure (1). Location Map of the Study Site

Materials and Methods

Materials

Soil Samples Were Collected From Daung-Yway Village And Sauk-Taw-Wa Village, Amarapura Township, Mandalay Region. Two Soil Samples Were Dug In The Depth Of Twelve Inches Of The Surface Before Cultivation Of Rice. In The Laboratory, The Samples Were Spread Out In Shallow Trays To Dry In The Atmosphere. When They Were Dried, The Samples Were Sieved Through A 2mm Sieve Was Rubbed Up In Motor With A Pestle And The Material Was Again Sieved. The Sample Passing The Sieve Was Used For Subsequent Analysis.

Methods

In All Analytical Procedure Of The Experiments, Recommended Standard Methods And Techniques Were Applied. Various Conventional Modern Techniques Instruments Were Used Throughout The Experimental Procedures. All Experimental Data Were Computed On The Statistical Basis. The Apparatus Consist Of Conventional Lab Ware, Glassware And Modern Equipment. The Moisture Contents Of The Soil Samples Were Measured By Oven Method. Ph Was Measured By Using Ph Meter. The Electrical Conductivity Of The Samples Was Determined By Using Hach Model Electric Conductivity Meter At Soil Survey Section, Irrigation Department, Yangon. Determination Of Available Nitrogen By Alkaline Permanganate Method, Determination Of Available Phosphorus By Olsen's Method And Determination Of Available Potassium By Using1n Ammonium Acetate Extraction Method Were Performed. Determination Of Texture By Hydrometer Test Was Performed At Soil Science Department, Agricultural Research Center, Yezin. Exchangeable Calcium And Magnesium Were Determination By Using Titration Method. Mineral Constituents Present In Two Agricultural Soil Samples Were Determined By The Energy Dispersive X-Ray Fluorescence (Edxrf) Spectrophotometer At Urc, Yangon.

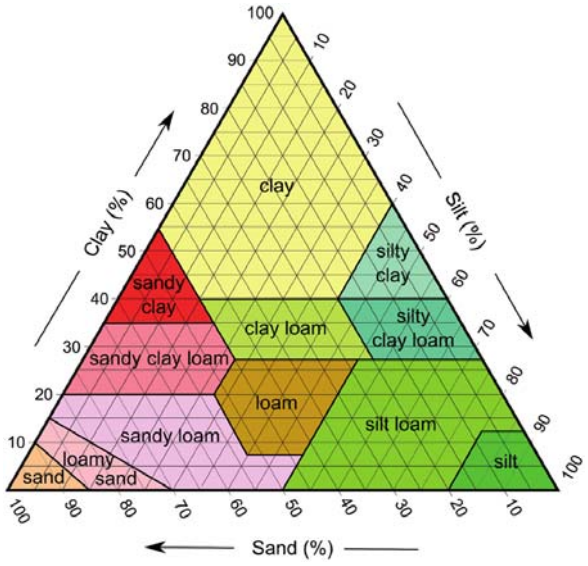

Figure (2). Soil Texture Triangle.

Figure (3). Daung-Yway Village Soil Sample

Figure (4). Sauk-Taw-Wa Village Soil Sample

Results and Discussion

Physical Properties of Soil Samples

Soil Moisture Plays An Important Role In The Development Of Weather Patterns And The Production Of Precipitation. Soil Moisture Is A Key Variable In Controlling Evaporation And Plant Transpiration. In This Research Work, The Moisture Percent Of The Soil Samples Were Shown In Table 1 .The Moisture Percent Of Soil Samples Were Found To Be 7.93% For Sample (1) And 5.76% For Sample (2). The Ph Values Of Soil Samples Were Found To Be 7.4 For Sample (1) And 7.9 For Sample (2). It Was Found That These Soil Samples Were Slightly Alkaline Condition. Many Plants Do Well When Ph Is 6.4 And 7.0, Just A Shade On Acidic Side. Alkaline Soils Have Ph 7.5 To 8.5 And Acidic Soils Have 4.0 To 6.5. Soils With Ph Values Outside These Ranges Are Usually Toxic To Most Plants. The Ph Of Soil Plays An Important Role For Cultivation. Most Vegetables And Crops Grow Best On Soil With Optimum Ph Ranging From 5.5 To 7.5. This Range Of Ph Was Favorable For Two Reasons For Sufficient Microorganism To Break Down Organic Matter And Also The Best Range For Nutrients Availability.

The texture percent of the soil samples were shown in Table 1. The texture of soil sample (1) was found to be clay (22% sand, 17%silt and 61% clay) and sample (2) was also found to be clay (17% sand, 22% silt and 61% clay). In general, sandy soils are usually not as fertile. Crops can grow in sandy soils. Fine textured soils are more fertile and are able to retain moisture and nutrients efficiently.

Table (1). Physical Parameter of the collected Soil Samples

Parameter		Sample (1)	Sample (2)
Moisture (%)		7.93	5.76
Texture (%)	Sand	22	17
	Silt	17	22
	Clay	61	61
pH		7.4	7.9
EC (mmhos/cm)		217	110
Color		light brown	light brown

Sample (1) = Daung-yway Soil Sample

Sample (2) = Sauk-taw-wa Soil Sample

Major Nutrients of the Collected Soil Samples

Available Nitrogen

Nitrogen helps plants with rapid growth increasing seed and fruit production and improving the quality of leaf and forage crops. The leaves of plants growing with a low level of nitrogen compared with other nutrients are pale yellow to reddish green which darken rapidly as the nitrogen supply increases and become very dark green when it is excessive. The results were shown in Table 2. Available nitrogen of soil sample (1) was medium value of 7.6 $mgkg^{-1}$ as well as sample (2) was also medium value 80 $mgkg^{-1}$.

Available Phosphorus

Phosphorus that can be absorbed to meet plant. Plants need phosphorus for strong root growth fruit stem and seed development, diseased resistance and general plant vigor. The results were shown in Table 2. Available phosphorus of both soil samples were medium value 15$mgkg^{-1}$ and 13 $mgkg^{-1}$.

Available Potassium

Potassium is essential for life and is present in all soils. This nutrient sometimes called potash is essential for vigorous growth diseased resistance, fruit and vegetable flavor and development and general plant function. The results were shown in Table 2. Available potassium of soil sample (1) was 205 $mgkg^{-1}$and sample (2) was 223 $mgkg^{-1}$. High potassium value is necessary for the production of the best quality of grain and fruit. But available potassium contents of two soil sample were medium level according to literature value.

Table (2). Major Nutrients of Soil Samples

Sample	N	P	K	Organic matter
	($mgkg^{-1}$)	($mgkg^{-1}$)	($mgkg^{-1}$)	(%)
Daung-yway	76	15	205	1.62
Sauk-taw-wa	80	13	223	1.74

Classification of Available NPK

Available N ($mgkg^{-1}$)		Available P ($mgkg^{-1}$)		Available K ($mgkg^{-1}$)	
< 30	very low		-		-
30-60	low	<10	low	< 150	low
60-90	medium	10-20	medium	150-250	medium
90-120	high	20-40	high	250-800	high
> 120	very height	> 40	excessive	> 800	excessive

Exchangeable Calcium and Magnesium

The predominant exchangeable cation is calcium. It is necessary not only to preserve desirable physical, chemical and biological properties in a soil but also to serve as a source of calcium as a plant nutrient. Soil minerals, organic materials, fertilizers and dolomitic limestone are sources of magnesium for plants. The results were shown in Table 3. In this

research work, the contents of exchangeable calcium in soil samples were found to be 107.4 meq/L for sample (1) and 87.5 meq/L for sample (2). The contents of magnesium were also found to be 27.2 meq/L for sample (1) and 41.8 meq/L for sample (2). Sodium adsorptive ratio (SAR) of these two soil sample were 1.46 and 1.55 respectively.

Table (3). Exchangeable Cation Contents and Sodium Adsorptive Ratio (SAR) of Soil Samples

Sample	meq/L		SAR
	Ca++	Mg++	
Daung-yway	107.4	27.2	1.46
Sauk-taw-wa	87.5	41.8	1.55

Elemental contents of soil samples by EDXRF Analysis

This experiment was carried out by using EDX technique. Silicon was found to be most abundant element in this two soil sample. Silicon gives plants mechanical strength and may help minimize water loss and increase diseased resistance. Iron was found to be second highest value in two soil sample. 11.144% and 7.937% potassium were detected in two soil sample. Potassium is essential for the movement of sugar within the plant and for starch formation. Micronutrients which include boron, chlorine, copper, iron, manganese, molybdenum, nickel and zinc are required in lower amounts than other essential nutrients. High pH (greater than 7.2) can limit availability of iron, manganese and zinc. The content of zinc was found to be 0.134% for sample (1) and 0.127% for sample (2). Zinc helps in the production of a plant hormone responsible for stem elongation and leaf expansion. Calcium content of sample (1) was 4.710% and sample (2) was 16.603%. The content of copper was found to be 0.115% for sample (1) and 0.096% for sample (2). Copper is an essential constituent of enzymes in plants and important for reproductive growth. Table 4 shows comparison of mineral contents between soil samples (1) and (2).

Table (4). Mineral Constituents of Soil Samples by EDXRF Analysis

Minerals	Daung-yway	Sauk-taw-wa
Si	41.136 %	35.185 %
Fe	38.425 %	35.935 %
K	11.144 %	7.937 %
Ca	4.710 %	16.603 %
Ti	3.0282 %	3.120 %
Zr	0.440 %	0.288 %
Mn	0.335 %	0.348 %
Rb	0.185 %	0.129 %
Zn	0.134 %	0.127 %
Cu	0.115 %	0.096 %
Sr	0.096 %	0.175 %

Conclusion

Comparative investigation of two soil sample from Daung-yway and Sauk-taw-wa villages was subjected for agricultural and use of local people. The pH values of soil samples were found to be 7.4 for sample (1) and 7.9 for sample (2). Thus, these samples are slightly alkaline condition. These pH values were suitable of rice planting since optimum soil pH range for rice was 5.5 to 7.5

Moisture contents of soil sample (1) and soil sample (2) were 7.93% and 5.76%. Soil sample retained much more water than soil sample 2 and therefore it was better than sample (2) for paddy planting. Electrical conductivities (EC) of soil samples extracts showed the level of soluble salts in these soils as 217 and 110 mmhos/cm for samples (1) and (2). The color of soil samples were light brown color. Both soil samples showed their textural class as clay.

The major nutrients, N, P, K contents were found to be medium level (76 $mgkg^{-1}$, 15 $mgkg^{-1}$, 205 $mgkg^{-1}$ and 80 $mgkg^{-1}$, 13 $mgkg^{-1}$, 223 $mgkg^{-1}$) for soil sample (1) and soil sample (2). Exchangeable cation contents and sodium adsorptive ratio of these two soil samples were determined and it was found that the resulting values were not different significantly.

From the determining of elemental contents of two soil sample, it was detected that silicon was found to be highest value and iron was found to be second highest value in two soil sample. In sample (1), K 11.144%, Ca 4.710%, Ti 3.028%, Mn 0.335%, Zn 0.134% and Cu 0.115% were obtained. In sample (2), K 7.937%, Ca 16.603%, Ti 3.120%, Mn 0.348%, Zn 0.127% and Cu 0.096%. This result of soil analysis also gives information that there were no toxic heavy metals (Hg, As, Pb) in two soil sample.

According to some physical parameters of two soil sample, Daung-yway soil can be more effective than Sauk-taw-wa soil for agriculture especially for paddy.

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