Study on Evaluation of Some Properties of Soil from Peanut Farms in Sagaing Region

Myat Sandar Hla

Abstract

This study was undertaken to evaluate the some physicochemical properties of soil samples from three different peanut farms in Myin Hmwe village tract at Sagaing Township. In this study, three soil samples from different farms in Myin Hmwe village tract were collected at the times of forty days after planting in early September of 2017 and 2018. Farms in that area are planted the whole year annually. Soil from those farms ought to be analyzed to determine soil fertility level and identify nutrient deficiencies and potential toxicities. They are also important for monitoring the stages of land degradation. Therefore, some properties of soil such as pH, moisture, bulk density, porosity, organic carbon and humus percent, electrical conductivity, macronutrients and elemental contents were determined. pH values of soil samples in two periods were found that the range of (7.6 - 8.5) and (8.6-9.3) respectively. They were slightly alkaline and strongly alkaline. Moisture percent of soil samples in two periods were found in the range of (0.60-0.76)% and (0.46 - 0.59)%. Organic carbon percent of soil samples in both periods were in the range of (0.08-0.24) and (0.27-0.35)% respectively. Humus percent of soil samples in both periods were in the range of (0.14-0.28) and (0.47-0.60)% respectively. These values were below the permissible limit. Electrical conductivity values of those were in the range of (84-112) μS/cm and (123-142) μS/cm. It was below the permissible limit of 200μS/cm. Bulk density values of soil samples in both periods were (1.24-1.32) and (1.19-1.25) g/dm^3 and porosity percent of soil samples were found the range of (47.49-47.94)% and (45.78-57.56)% respectively. It was found the good porosity percent for plant growth. Macronutrients such as total nitrogen percent were (0.08-0.13) % and (0.11-0.14%) in both periods. Available phosphorus: (118.3- 170.5) ppm and (122.3-169.3) ppm and available potassium (0.74-3.05) ppm and (0.84-3.62) ppm were found in both periods. Elemental contents of soil samples in both periods were given descending order: percent of silicon, iron, calcium, potassium, titanium, manganese, zirconium, strontium, rubidium, ytterium, copper and zinc. Peanut plants prefer slightly acidic condition so the peanut farms selected in this study ought to be amended so as to get suitable pH level. Low organic carbon percent, nitrogen percent, available potassium and high contents of available phosphorus must be noticeable and monitored. However, some physicochemical properties obtained in this study indicate no harmful effect on those farms.

Keywords: Bulk density, Porosity, Electrical conductivity, Organic carbon, elemental content

Introduction

Sagaing Region is located in the north-western part of the country between latitude 21º31´ north and longitude 94º 97´ east. It has an area of 93,527 km^2 and population (1996) of over 5,300,000. The capital is Monywa. It has 198 wards and villages, 38 townships and 8 districts: Sagaing, Shwebo, Monywa, Katha, Kale, Tamu, Mawlaik and Hkmti. Myin Hmwe village tract is located at the Sagaing-Monywa road in Sagaing Township. There are small-scale farms in Myin Hmwe village tract. According to interview with farm owners, these farms are mainly rotated oil crops like peanut, sesame and sometimes a variety of beams like chicken peas, long beams and pigeon peas are cultivated.

Soils are composed of solids, minerals and organic matter and pores which hold air and water. It supports plant growth, absorbs, buffers, and transforms chemical flows, retains and stones flood water, and renews water supplies. Soil quality is the capacity of the soil to perform these beneficial functions. As soils naturally vary in their capacity to perform these functions, a soil of excellent quality for one function may be unsuitable for another. Soil pH is a measure of soil solution's acidity and alkalinity of soil influenced by both acid and base-

Associate Professor, Dr, Department of Chemistry, Sagaing University

forming ions in the soil. Soil moisture is a key variable in controlling the exchange of water and heat energy between the land surface and the atmosphere through evaporation and plant transpiration (Levy and Miller, 1997).

Bulk density is influenced by the amount of organic matter in soils, their texture, constituent minerals and porosity. Bulk density of a soil is a dynamic property that varies with soil structural conditions. In general, it increases with profile depth, due to changes in organic matter content, porosity and compaction. Porosity is the fraction of the total soil volume that is taken up by the pore space. Soil electrical conductivity may be useful in production agriculture because it is related the factors that affect soil productivity, use and management (Matthess, 1982)**.**

Nitrogen is taken up by plants from the soil organic and inorganic forms. Organic nitrogen occurs naturally in the soil. It can also be added from manure and biological fixation legumes. Inorganic mineral nitrogen includes ammonium, nitrite and nitrate.

Because phosphorus is bound to most soils, only a fraction is available to plants. Phosphorus in soil is found in two forms-organic and inorganic mineral. Although dynamic transformations between forms occur continuously, 50 to 75 % of phosphorus in most soils.

Potassium is one of the nutrients essential for plant growth. It is required by plants in large amount. Potassium salts are soluble because of low electronegativity of potassium.

Soil organic matter plays a key role in nutrient and can help improve soil structure. Soil organic matter is different to organic carbon in that it includes all the elements (hydrogen, oxygen, nitrogen etc.) that are components of organic compounds, not just carbon. Organic matter is an important source of nutrients for plants. Organic carbon represents approximately 50% of soil organic matter. Soil organic carbon level of farmland was influenced by climate (mainly temperature and precipitation) and farming practices including crop residue incorporation, nitrogen fertilizer use crop yield etc. Climate warming may increase the rate of decomposition. Effect of precipitation on soil organic carbon is mostly known to be positive because in general soil organic carbon increases with increase in precipitation. In general, nitrogen is the most limiting nutrient in crop protection system. It promotes the production of crop dry matter and therefore carbon input to the soil while chemically stabilizing carbon in the soil, thereby potentially increasing soil carbon storage.

Among several improved farming practices, retention of crop residues strongly contributed to the restoration of soil organic carbon, but there was no synergistic effect between nitrogen fertilizer rate and crop yield on increase in soil organic carbon. The soil organic carbon content decreased with an increase in mean annual temperature (Levy, G. and W. Miller, 1997).

Materials and Methods

Determination of Some Physicochemical Properties of Soils from Farms in Myin Hmwe Village Tract

pH of soil samples from farms from Myin Hmwe village tract were determined by using pH meter (Fig. 1). Moisture content of soil samples were determined by oven dried method (Nathan *et al.*, 1998).Bulk density of soil samples were determined by the core method. Porosity of soil samples were determined by Pycnometer (Nimmo and Akstin, 2004).Organic carbon and humus in soil samples were determined by Walkley Black method (Jackson, 1958). Total nitrogen in soil was determined by Kjeldahl method. Phosphorus was determined by colorimeter (Model - 312 EI, India). Potassium concentration was determined by flame photometer. Electrical conductivity contents were determined by conductivity meter. Elemental contents of soil samples were determined by EDXRF method.

Figure (1) Sampling locations at Myin Hmwe Village Tract

Results and discussion

Table (1) and figure (2) show that pH values of soil samples from peanut farms in both periods of 2017 and 2018 before harvesting time. In 2017, it was found the pH range of (7.6 - 8.5) which was slightly alkaline. However, in 2018 pH values of those were getting strong alkaline nature, (8.6 - 9.3).

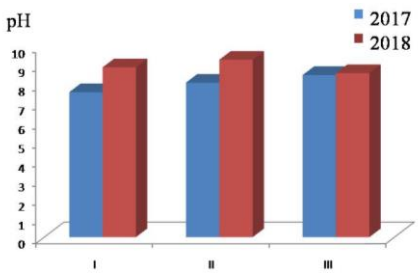


Figure (2). pH values of soil from peanut farms in Myin Hmwe Village Tract before harvesting time of 2017 and 2018

Table (1). pH Values Of Soil from Peanut Farms in Myin Hmwe Village Tract before Harvesting Time of 2017 and 2018

No	Sample	pH	
		2017	2018
1	I	7.6	8.9
2	II	8.1	9.3
3	III	8.5	8.6

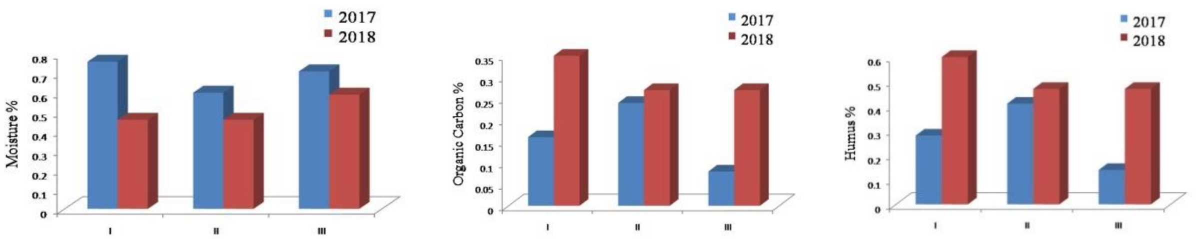
Classification (Beerneart, 1994)
pH 4.0 – 5.3 very acidic
5.3 – 6.0 moderately acidic
6.0 – 7.0 slightly acidic
7.0 – 8.5 moderately alkaline

Table (2) and figure (3) depict the moisture percents, organic carbon percents and humus percents of soil samples in both periods. The ranges of above values in both periods are as follows: moisture percent: (0.60 - 0.76)% and (0.46 - 0.59)%, organic carbon percent: (0.08 - 0.24)% and (0.27-0.35)% humus percent: (0.14 - 0.41) %and (0.47 - 0.60)%. Organic carbon and humus percents of soil samples in 2018 were found higher than those of 2017. This is due to cultivation frequency of those farms.

Table (2). Moisture %, Organic Carbon % and Humus % of Soil from Peanut Farms in Myin Hmwe Village Tract before Harvesting Time of 2017 and 2018

No	**Sample**	**Moisture%**		**Organic Carbon %**		**Humus %**	
		2017	**2018**	**2017**	**2018**	**2017**	**2018**
1	I	0.76	0.46	0.16	0.35	0.28	0.60
2	II	0.60	0.46	0.24	0.27	0.41	0.47
3	III	0.71	0.59	0.08	0.27	0.14	0.47

Classification (Beerneart, 1994)
4.2 - 6.0 % High humus content
2.0 - 4.2 % Medium humus content
Classification (Landon, 1991)
< 4 % low Organic Carbon
4-10 % medium Organic Carbon



(a) **(b)** **(c)**

Figure (3). (a) Moisture %, (b) Organic carbon % and (c) Humus % of soil from peanut farms in Myin Hmwe Village Tract before harvesting time of 2017 and 2018

Table (3) and figure (4) show that electrical conductivity values of soil samples in both periods. The ranges of electrical conductivity values of soil samples in 2017 and 2018 were (84 - 112) and (123 - 142) µS/cm. This pattern was similar in the case of organic carbon and humus percents of soil samples. Those values were below the permissible limit.

Table (3).Electrical Conductivity of Soil from Peanut Farms in Myin Hmwe Village Tract before Harvesting Time Of 2017 and 2018

No	**Sample**	**Electrical Conductivity µS/cm**	
		2017	**2018**
1	I	84	123
2	II	106	133
3	III	112	142

Permissible limit 200 µS/cm (Beerneart, 1994)

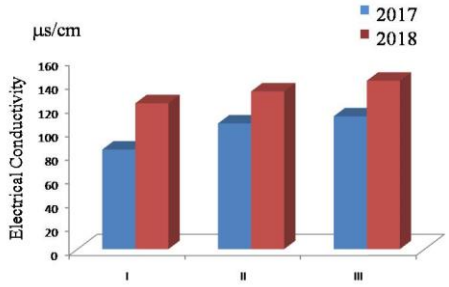


Figure (4). Electrical conductivity of soil from peanut farms in Myin Hmwe Village Tract before harvesting time of 2017 and 2018

Table (4) and figure (5) illustrate that bulk density values of soil samples in both periods. Their ranges: (1.24 - 1.32) g/ cm^3 and (1.19 - 1.25) g/ cm^3 in 2017 and 2018 respectively. These were agreed with the plant restricted value of plant growth.

Table (4). Bulk Density of Soil from Peanut Farms in Myin Hmwe Village Tract before Harvesting Time of 2017 and 2018

No	**Sample**	**Bulk Density g/cm^3**	
		2017	**2018**
1	I	1.24	1.20
2	II	1.32	1.19
3	III	1.25	1.25

Permissible limit 1.6 g/mL (McKenzie et *al*., 2004)

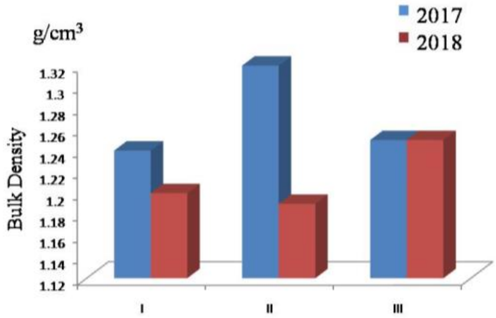


Figure (5). Bulk density of soil from peanut farms in Myin Hmwe Village Tract before harvesting time of 2017 and 2018

Table (5) and figure (6) show that porosity percent of soil samples in the ranges of (47.49 - 47.94) and (45.78 - 57.56) % in 2017 and 2018 respectively. These were found good porosity percent for plant growth.

Table (5) Porosity of Soil from Peanut Farms in Myin Hmwe Village Tract before Harvesting Time of 2017 and 2018

No	Sample	Porosity %	
		2017	2018
1	I	47.94	56.19
2	II	47.49	57.56
3	III	47.93	45.78

Classification (Beerneart, 1994)
30 – 40% Poor porosity
40 – 45% Moderate porosity
45 – 50% Good porosity

Figure (6) Porosity of soil from peanut farms in Myin Hmwe Village Tract before harvesting time of 2017 and 2018

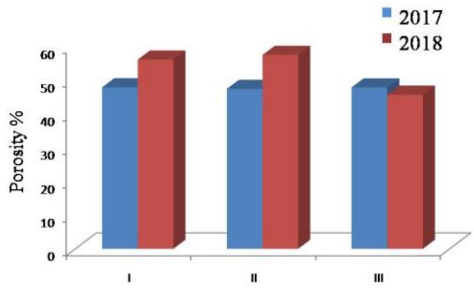


Table (6) and figure (7) depict that total nitrogen percent of soil samples in both periods. The ranges of those were (0.08 - 0.13) % and (0.11 - 0.14) % in 2017 and 2018 respectively. Low total nitrogen percent in both periods were found.

Table (6). Total Nitrogen % of Soil from Peanut Farms in Myin Hmwe Village Tract before Harvesting Time of 2017 and 2018

No	Sample	Total N (%)	
		2017	2018
1	I	0.09	0.11
2	II	0.13	0.14
3	III	0.08	0.14

Classification (Havlin*et al*., 1999)
< 0.15 % Low
0.15 - 0.25 % Medium
> 0.25% High

Figure (7). Total nitrogen % of soil from peanut farms in Myin Hmwe Village Tract before harvesting time of 2017 and 2018

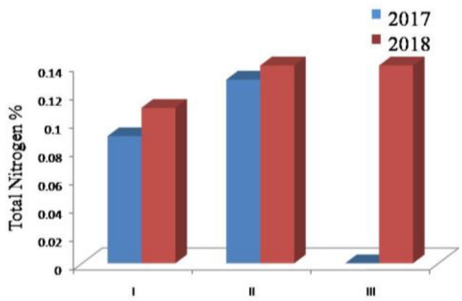


Table (7) and figure (8) show that available phosphorus values of soil samples were found in both periods. They range of (118.3 - 170.5) ppm and (122.3 - 169.3) ppm respectively.Very high phosphorus contents of soil samples were found in both periods.

Table (7). Available Phosphorus of Soil from Peanut Farms in Myin Hmwe Village Tract before Harvesting Time of 2017 and 2018

No	Sample	Available P (ppm)	
		2017	**2018**
1	I	150.3	168.6
2	II	170.5	169.3
3	III	118.3	122.3

Classification (Halvin *et al*., 1999)
> 12 ppm High available phosphorus
8-11 ppm Medium available phosphorus
4-7 ppm Low available phosphorus

Figure (8). Available phosphorus of soil from peanut farms in Myin Hmwe Village Tract before harvesting time of 2017 and 2018

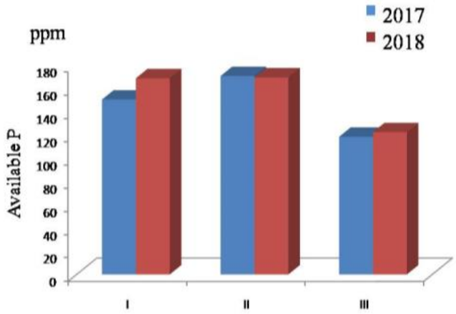


Table (8) and figure (9) show that available K_2O of soil samples in 2017 and 2018. The ranges of (0.74 - 3.05) and (0.84 - 3.62) ppm were found in 2017 and 2018 respectively. Very low K_2O contents of soil samples were found in both periods.

Table (8). Available K_2O of Soil from Peanut Farms in Myin Hmwe Village Tract before Harvesting Time of 2017 and 2018

No	Sample	Available K_2O (ppm)	
		2017	**2018**
1	I	1.42	1.98
2	II	0.74	0.84
3	III	3.05	3.62

> 30ppm Medium available potassium contents

Figure (9).Available K_2O of soil from peanut farms in Myin Hmwe Village Tract before harvesting time of 2017 and 2018

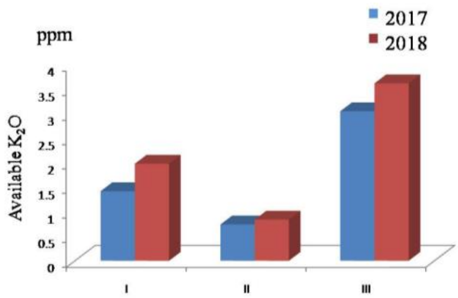


Table (9) shows that elemental contents as oxide form in both periods. Silica is most abundant and Yttrium is a least in those soil as usual. Order of elemental contents of soil samples in both periods are as follow: Si > Fe > Ca > K > Ti > Mn > Zr > Sr > Rb > Y>Cu>Zn.

Table (9). Elemental Determination of Soil from Peanut Farms in Myin Hmwe Village Tract before Harvesting Time of 2017 and 2018

No	**Element**	**Content %**					
		I		**II**		**III**	
		2017	**2018**	**2017**	**2018**	**2017**	**2018**
1	Si	40.131	48.120	33.056	49.587	40.350	32.819
2	Fe	18.010	20.855	26.963	22.537	21.689	35.254
3	Ca	14.132	13.059	8.754	10.565	12.001	14.182
4	K	10.421	12.592	27.505	13.032	23.651	12.272
5	Ti	2.912	3.648	2.055	2.710	1.334	2.536
6	Mn	0.816	0.762	0.852	0.668	0.520	1.016
7	Zr	0.311	0.401	0.217	0.297	0.154	0.735
8	Sr	0.312	0.287	0.218	0.260	0.103	0.583
9	Rb	0.212	0.245	0.138	0.210	0.080	0.533
10	Y	0.051	0.032	0.027	0.028	0.016	0.070
11	Cu	0.001	0.001	0.001	0.001	0.001	0.001
12	Zn	0.000	0.000	0.001	0.001	0.001	0.001

Conclusion

Soil analysis of Myin Hmwe village farms in this study indicates strong alkaline nature of soil samples before harvesting time in 2018 and it should be amended with elemental sulphur to reduce the pH of a soil and to keep the pH level balance. High phosphorus contents of soil samples in this study should be monitored and proper analysed. Low nitrogen and organic carbon percents of soil samples were also found. Balance fertilization should be widely applied for optimization of integrated economic benefits and ecosystem services. Increasing the input of nitrogen fertilizer increased soil organic carbon only when crop residues were returned to the soil. In case of elemental contents of soil samples, Si contents of soil samples were found highest and Zn contents of soil samples were found lowest in both sampling periods. This may be due to high phosphorus contents of soil samples lock up Zn content.The finding in this paper contributes to sustainable intensification as it helps to produce minimizing nutrient imbalance, reducing costs and limiting environmental damage through the targeted and precise use of inputs.

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References

Beerneart, F., (1994). *Simple and Practical Methods to Evaluate Analytical Data of Soil Profiles.* Dschang: Soil Science Department Belgian Cooperation, 111

Havlin, J.L., J.D. Beaton, S.L. Tisdale and W.L. Nelson, (1999). *Soil Fertility and Fertilizer: An Introduction to Nutrient Management.* New Jersey: 6th ed., Upper Saddle River, Prentice Hall

Jackson, M.L., (1958). *Soil Chemical Analysis. New Jersey:* Prentice Hall Inc., 214-221

Landon, J.R., (1991). *Booker Tropical and Soil Manual.A Handbook for Soil Survey and Agricultural Land Evaluation in the Tropics and Sub-tropics.* New York : John Wiley, 94-95.

Levy, G. and W. Miller., (1997)." Aggregate Stability of Some Southern US Soils". *Soil Science Society of America Journal,* **61,** 1176- 1182

Matthess, G., (1982). *The Properties of Groundwater.* NewYork : John Wiley, 397

McKenzie, N.J., D.J., Jacquier, R.F. Isbell and K. L. Brown, (2004). *Australian Soils and Landscape - An Illutrated Compendium.* Collinwood. CSIRO Publishing

Nathan, M.V., S.M. Combs, K. Frank, D. Beegle and J. Denning, (1998). "Recommended Chemical Soil Test Procedure." *North Central Region Research Publication*, **221**, 5-64

Nimmo, J.R. and K.C.Akstin, (2004). "Hydraulic Conductivity of a Sandy Soil at Low Water Content after Compaction by Various Methods". *Soil Sci. Soc. Am. J.*,**52,** 303-310