

PROFILE DISTRIBUTION OF SOME PRIMARY MACRO NUTRIENTS AND EXCHANGEABLE BASES IN KANO UNIVERSITY OF SCIENCE AND TECHNOLOGY, RESEARCH AND COMMERCIAL FARM, GAYA

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ABSTRACT

The level of some primary macro nutrients and exchangeable bases in Kano University of Science and Technology, Wudil Teaching, Research and Commercial Farm Gaya were evaluated in 2012 to determine their status within the soil profile. The total of nineteen (19) samples were collected from four (4) different profile representative sites of the soil and were analysed based on presented standard laboratory procedures that the soils are slightly acidic to alkaline in nature (mean PH of 6.7) while the texture ranges from sand loam to sandy clay loam. The value of exchangeable bases, CEC available phosphorous and total nitrogen are mostly found to be low in most of the units within the study area. On the other hand, the fertility of the soil was generally low, therefore application of both organic and inorganic fertilizers as well as planting of cover crops are suggested to improve soil organic matter level and CEC.

KEYWORDS: Soil profile, Pedons, Exchangeable Bases and Macronutrients.

INTRODUCTION

The study area is located within the Sudan Savannah and the mean annual rainfall recorded in ten (10) years 2001 – 2011 of KNARDA Kano Station was 773.4mm. The soils of the study area is mainly sandy loam driven from wind drifts materials, it is dark and brown in colour having high content of silt. The major crops grown in the area include millet, maize, sorghum and cowpea.

The depth of the soil affects the movement and also the availability of nutrient in the soil. However, if the nutrients are strongly bond to the soil particles the crops may shown signs of deficiency. If the soil is coarse – textured, plant nutrients are easily leached off the profile when the rainfall is heavy. The depth of the soil is important in areas where the rainfall is unreliable or where the rainfall is seasonal. In that case only the deep soil can hold enough water to meet the requirement of crops during the dry period.

Organic matter and essential nutrients, particularly primary maconutrients, N.P and K as well as of Ca and Mg are major determinants of soil fertility. (Sign, 1999). Due to repeated cultivation removal of plant nutrients, erosion, burning and poor cultural practices, most cultivated soils have been depleted of the reserved nutrients and therefore unable to produce good yield.

A fertile soil most have an even distribution of pores which will be able to hold the air and water and these pores must be connected to allow free movement of air and water. An optimum condition would therefore, be neither very acidic nor very basic. Some areas have a high concentration of soluble salts or some metallic salts and those are some of the places that may be infertile as a results of injurious substances (Weil, 2004).

The research is concerned with the profile distribution of some primary macronutrients and exchangeable bases in Kano

University of Science and Technology, Research and Commercial Farm located in Gaya Local Government Area on a good knowledge of the soil physical and chemical properties which will served as a guide in the proper management of these soils.

A research of this nature is justified on basis that it provides information. Considering the high increase in human population there is a need to increase food supply, and these nutrients play an important role for the plant growth and development. Despite the large resources that have been expanded by the government as well as farmers to supply various organic and inorganic substances toward replenishing the soil, therefore any research which is aimed at providing information about this impact cannot be rejected by the target population.

The main aims and objectives of the research were to determine some available primary macro – nutrients and exchangeable bases within the soil profile of the study area for the production of maize, guinea corn, ground nut, millet and vegetables.

MATERIALS AND METHODS

Location of the Study Area

The study was conducted at Kano University of Science and Technology, Teaching, Research and Commercial Farm, situated in Gaya Local Government Area of Kano State. It is located on latitude 11N to 120 14N and longitude 7) 38E to 8038E.

Soil Sampling and Preparation

Four soil profile pit were dug at different locations of the study area on the bases of land use. Thus, Livestock Production Unit, Range Unit, Crop Production Unit, and Horticultural Unit. Each of the above mentioned profile was 1.5mx1.5m (150cm length) and the samples were collected according to pedogenic horizons identified in each profile pit.

The sample were also collected from the base of each profile pit upwards in order to avoid contamination of the sample between one horizon to another, it is also collected from four angles of each horizon. Nineteen (19) samples were collected from (4) profile pits i.e. five (5) samples from each profile pit in three (3) units and four (4) samples were collected from the remaining one (1) unit. The samples were properly labeled and put in a polythene paper.

The samples were air - dried, thoroughly mixed and gently grounded using pestle and mortar than later sieved through a 2mm sieve and stored in a plastic bags for laboratory analysis.

Laboratory Analysis

Total nitrogen was determined by regular macro - Kjeldahl method (Hessen, 1971) while organic carbon content of the soil sample were determined using walkley black method (W. B, 1937). Available phosphorous were determined using ascorbic acid method (Olsen, 1965) and exchangeable bases were determined by using neutral ammonium acetate saturation method as described by (Chapman, 1956). The data were analyzed using mini-tab software F-test. Means that were significantly different were separated by DMRT.

RESULTS AND DISCUSSION

Particle size distribution

Table 1 shows the particle size distribution in percentage of the soil in the study area. The sand, silt and clay content ranges from 69 - 88, 3- 9 and 12 - 26 respectively. The higher percentage of sand were obtained from the soil collected in horticultural unit while the least value was also obtained from the soil

collected in range unit. The sandy nature of these soils could be attributed to the sandy nature of parent materials (Lekwa, 1992).

The silt content was low ranges from (1 - 7%) with an average of 3.8%. The highest percentage of silt was obtained from animal production site. This could attributed to the eluviations of clay and other suspended materials from the surface horizon. Conclusively the clay contain was low and increase with depth this increase was probably due to alleviation process.

Total Nitrogen and Available Phosphorus

The total nitrogen and available phosphorus content at the soils in the study area were low especially in three units viz crop production unit, range unit and horticultural unit as shown in table 2. The low level of total nitrogen in these units could be attributed to the continuous cultivation, erosion, leaching and burnings. On the other hand the total nitrogen was found to be medium in animal production unit and this might be due to long fallowing.

Exchangeable Bases

The exchangeable bases contents are shown in Table 3. The exchangeable Ca, Mg and Na were low in the soils of the study area. The low content for these exchangeable Ca and Mg is due to low in CEC of the soil resulting in the low content of clay and organic matter. The low content of exchangeable Na indicated that the sodicity will not be a problem if proper soil and water management practices are maintained. Potassium was found to be high in the study area as potassium availability is not a serious problem since weathering of soil minerals replaced annual deflation (Havlin *et al.*, 2005).

Table 1: Particle Size Distribution of Soils in Kano University of Science and Technology, Research and Commercial Farm, Gaya.

S/N	Location	Horizon	Depth (Cm)	Particle Size Distribution (%)			Textural Classes
				Sand	Silt	Clay	
1	Animal Production Unit (APU)	O	0 - 20.4	75a	9a	16a	Sand loam
		A	20.4 - 62.4	73a	7a	20a	Sand loam
		E	62.4 - 103.5	77a	5a	18a	Sand loam
		B	103.5 - 150	83a (77)	5a (6.5)	12a (16.5)	Loamy sand Sandy loam
2	Range Unit (RU)	O	0 - 9	75a	7a	18a	Sandy loam
		A	9 - 59	81a	1a	18a	Loamy sand
		E	59 - 90	77a	1a	22a	Sand clay loam
		B ₁	90 - 126	79a	5a	16a	Sand loam
		B ₂	126 - 150	75a (77.4)	5a (3.8)	20a (18.8)	Sand loam Sandy loam
3	Crop Production Unit (CPU)	O	0 - 9	77a	5a	18a	Sandy loam
		A	9 - 29	73a	3a	24a	Sandy clay loam
		E	29 - 77	75a	3a	22a	Sandy clay loam
		B ₁	99 - 121	77a	5a	18a	Sandy loam
		B ₂	121 - 150	79a (76.2)	7a (4.2)	16a (19.6)	Sand loam Sandy loam
4	Horticultural Unit (HU)	O	0 - 10	71a	5a	24a	Sandy clay loam
		A	10 - 31	69a	5a	26a	Sandy clay loam
		E	31 - 67	75a	5a	20a	Sandy loam
		B ₁	67 - 117	79a	5a	16a	Sandy loam
		B ₂	117 - 150	78a (76.8)	4a (4.6)	18a (20.4)	Sandy loam Sandy loam
	Overall range			69 - 88	3 - 9	12 - 26	
	Overall mean			76.85	4.77	18.83	
	SE+			1.09	0.60	0.55	

Values in parenthesis represent means

Table 2: Total Nitrogen and Available Phosphorus Contents of Soils at Kano University of Science and Technology, Research and Commercial Farm, Gaya

S/N	Location	Horizon	Depth (Cm)	Total N (Gkg ⁻¹)	Available P (PPM (Mg Kg ⁻¹))
1	Animal Production Unit (APU)	O	0 - 20.4	0.73	10
		A	20.4 - 62.4	0.66	7
		E	62.4 - 103.5	0.38	7
		B	103.5 - 150	1.70 (0.86)	8 (8)
2	Range Unit (RU)	O	0 - 9	0.21	11
		A	9 - 59	0.35	8
		E	59 - 90	0.42	7
		B ₁	90 - 126	0.38	6
		B ₂	126 - 150	0.49 (0.37)	6 (7.6)
3	Crop Production Unit (CPU)	O	0 - 9	0.24	10
		A	9 - 29	0.31	7
		E	29 - 77	0.31	7
		B ₁	99 - 121	0.35	7
		B ₂	121 - 150	0.21 (0.28)	7 (7.6)
4	Horticultural Unit (HU)	O	0 - 10	0.24	10
		A	10 - 31	0.35	10
		E	31 - 67	0.45	8
		B ₁	67 - 117	0.42	7
		B ₂	117 - 150	0.39 (0.37)	8 (8.6)
Overall range				0.21 - 1.70	7 - 11
Overall mean				(0.47)	(7.95)
SE+				0.02	0.31

Values in parenthesis represent means

Table 3: Distribution of Exchangeable Bases (Na, K, Ca and Mg) of Soils at Kano University of Science and Technology, Research and Commercial Farm, Gaya.

S/N	Location	Horizon	Depth (Cm)	Na	K	Ca	Mg
Cmol/kg							
1	Animal Production Unit (APU)	O	0 - 20.4	0.16	0.43	4.16	0.21
		A	20.4 - 62.4	0.15	0.40	4.06	0.19
		E	62.4 - 103.5	0.17	0.34	3.12	0.19
		B	103.5 - 150	0.12 (0.15)	0.26 (0.36)	7.81 (4.78)	0.34 (0.23)
2	Range Unit (RU)	O	0 - 9	0.18	1.35	2.50	1.04
		A	9 - 59	1.03	2.60	1.36	0.69
		E	59 - 90	0.41	0.70	5.93	0.34
		B ₁	90 - 126	0.13	0.30	6.56	0.69
		B ₂	126 - 150	0.53 (0.46)	0.86 (1.16)	2.81 (3.83)	0.34 (0.62)
3	Crop Production Unit (CPU)	O	0 - 9	0.23	0.45	4.31	0.69
		A	9 - 29	0.32	0.61	3.12	0.69
		E	29 - 77	0.38	0.65	7.81	3.47
		B ₁	77- 121	0.16	0.32	8.12	1.04
		B ₂	121 - 150	0.17 (0.25)	0.38 (0.48)	7.81 (6.23)	1.04 (1.38)

Table 3 continue

S/N	Location	Horizon	Depth (Cm)	Na	K	Ca	Mg	
4	Horticultural (HU)	Unit	O	0 - 10	0.11	0.62	6.56	0.34
			A	10 - 31	0.32	0.68	7.18	0.69
			E	31 - 67	0.19	0.55	3.70	0.69
			B ₁	67 - 117	0.16	0.26	3.12	1.04
			B ₂	117 - 150	0.17	0.57	4.12	3.81
				(0.19)	(0.54)	(4.93)	(1.31)	
	Overall range			0.11 - 1.03	0.26 - 1.35	1.36 - 8.12	0.19 - 3.81	
	Overall mean			(0.26)	(0.63)	(4.94)	(0.88)	
	SE±			0.02	0.03	0.21	0.02	

Values in parenthesis represent means

Table 4: Rating for Soil Facility Classes

PARAMETER	LOW	MEDIUM	HIGH
Total NgKg ⁻¹	< 1.5	1.5 - 2.0	> 2.0
Bray/PMKg ⁻¹	< 8	8 - 20	> 20
Exch K CmolKg ⁻¹	< 0.20	0.20 - 0.40	> 0.40
Exch Ca CmolKg ⁻¹	< 5.0	5.0 - 10.0	> 10.0
Exch Mg CmolKg ⁻¹	< 1.5	1.5 - 3.0	> 3.0
Exch Na CmolKg ⁻¹	< 0.3	0.3 - 0.7	> 0.7
Org. Matter gkg ⁻¹	< 20	20 - 30	> 30

Source: FMA, WR & RD (1989) and FMA & NR (1990)

CONCLUSION

The level of some primary macronutrients and exchangeable bases were evaluated in Kano University of Science and Technology, Research Teaching and Commercial Farm located at Gaya. The results indicated that soils of the area generally have low content of total nitrogen, organic matter. Available phosphorous, exchangeable bases and CEC within the soil

profile with predominant sandy loam texture. The soil of the site are therefore, regarded as poor in fertility. The continuous cultivation led to the degradation of soils. It is therefore suggested that, proper and adequate organic and inorganic fertilizers application effective crop rotation technique and good soil management practices should be observed to restore the fertility status of these soils.

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