ISSN 2229-5518

DETERMINATION OF PHYSIOCHEMICAL PROPERTIES OF A SOIL AT BLOCKS (P) IN SAVANNAH SUGAR COMPANY (DANGOTE GROUP) NUMAN, ADAMAWA STATE.

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ABSTRACT: The study was carried out to assess the physiochemical properties of Block (P) of soils at Savannah Sugar Company (SSC) (Dangote Group). A total of 27 soil samples were collected at 9 selected units. The results indicated that the pH 6.97±0.29 to 6.97±0.76, EC 0.69±0.03 to 0.73±0.08 dSm^{-1}CEC (33.19±2.37 to 61.63±7.29), SAR (0.18±0.03 to 0.43±0.06) and an ESP of (1.90±0.17 to 4.07±0.40.29). Organic Matter Content range from 0.50±0.09 to 0.1.36±0.03. The research concluded that green cane harvesting should be encouraged and regular soil testing should be done to monitor the physiochemical properties of the soil at SSC farm.
Keywords: pH, EC, SAR, Soil Physio-chemical properties, SSC (Dangote Group)

1. INTRODUCTION

Soil is a mixture of organic matter, minerals, gases, liquids, and organisms that together support plants and animals life. The Earth's body of soil is called pedosphere which serves as water and mineral storage for transportation of nutrient into plant stomata cell and purification of mineral (both macro and micro nutrients) for plant uptake and growth, food and biomass production filtration. It is also habitat for organisms. Soil also comprised of organic and inorganic matter, which are intimately mixed together by natural processes such as weathering and Pedogenic. Soil is an important carbon reservoir, and it is potentially one of the most reactive to human disturbance [1] and climate change [2]. Soils can effectively remove impurities [3]. Soil consist of chemical, physical and biological characteristic or properties. The physical properties of the soil are available water holding capacity (WHC), texture, structure, strength, color, permeability, and temperature and bulk density. The soil chemical properties are pH, EC and Cation Exchange Capacity of the soil. The soil biological properties are earthworms, bacterial biomass, bacterial diversity, presence of pathogens, fungi, actinomycetes, and algae to mention but few. For example, sandy soils have a low water-holding capacity, whereas clay soils has high very high water-holding capacity. Loamy soil is dark in color, drains well, and allows air to move freely around plant roots.

The Physicochemical properties of soil that play a vital role in crop production are characterized as those that directly affect crop growth, such as water, oxygen, temperature and soil resistance, and others, such as bulk density, texture, aggregation and pore size distribution, that indirectly affect crop growth [4].
Physical and chemical characteristics of different soils vary in space and time due to variation in topography, climate, physical weathering processes, vegetation cover microbial activities, and several other biotic and abiotic variables [5].

2. MATERIALS AND METHOD

The study area is the Sugarcane Plantation of Savannah Sugar Company located in Numan Local Government Area (L.G.A) of Adamawa state, Nigeria. It lies between latitude 9^{0}10'N- 9^{0}39'N longitude 10^{0}25'E-12^0 55'E (Fig. 1). The plantation covers over 27,000 ha of land. The climate of the area is characterized by two distinct climatic seasons; Wet and Dry seasons, respectively. The wet season starts from April and ends in October while the dry season starts from November to the month of March of the preceding year. The mean annual rainfall is 676 mm; the wettest months are August and September. The annual mean temperature is 30^{0}C with minimum temperature in the period from November to February when the North East trade winds originated in the Sahara desert, reduces the air temperature considerably.

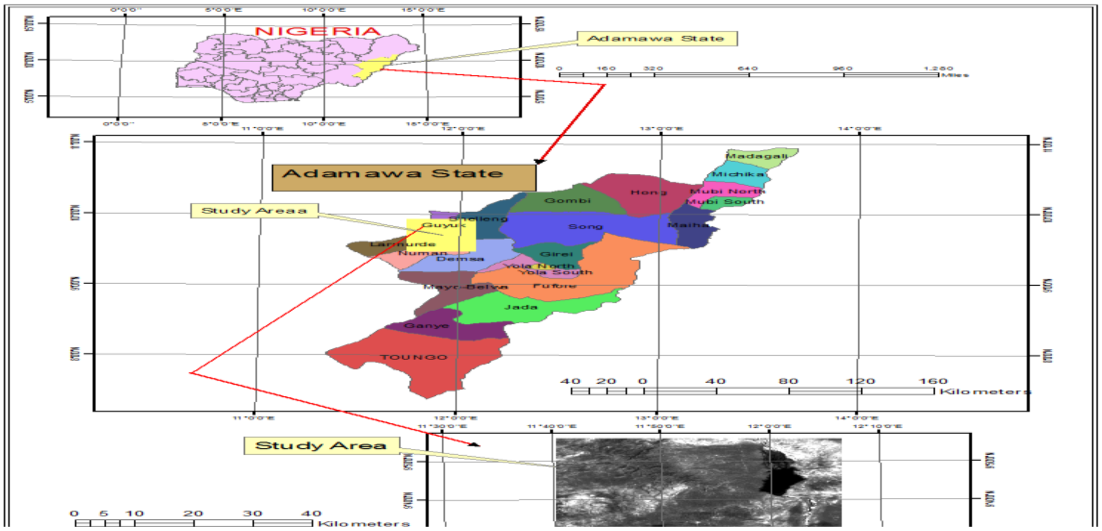

Fig. 1: Map of Adamawa State showing Numan and SSCL [6].

2.1 Soil Sample Collection:

Soil samples were randomly collected from the plantation. During the sampling, necessary care was taken to avoid sampling errors including abnormal occurrence in the field. The samples were taken at incremental depths of 0-20 cm down to a depth of 60cm in each unit. Thus, the samples were taken at 3 different points in field plot P1. The samples were carefully packaged and labelled for the laboratory analysis. Screw auger was used for the samples collection.

2.2 Sample Treatment and Analysis

Soil samples were air-dried, sieved, and analyzed in the laboratory using standard techniques. Particle size composition was obtained by hydrometer method [7]. Soil pH was determined in water (water Jenway 3015) meter at soil-water ratio of 1:2, after standardizing the pH meter at a buffer, EC was determined from the sample prepared for determination of pH. The particle size distribution was determined by a Bouyoucos-hydrometer [7]. The Na and K were measured with flame photometer while the Calcium and Magnesium were analyzed directly by Atomic Absorption Spectrophotometer. The Organic Matter Content was determine by Walkley-Black method [8], while ESP, SAR, and CEC where Determined by empirical

relationship (Eqn. 1)

$$\% C = \frac{(B-T)\ x\ F\ x\ 0.00399}{\text{Ws}}\ x\ 100 \qquad 1$$

Where:
% O.C = Percentage of Organic Carbon
B = Blank or Initial Burette reading
T = Titre Value at end point
F = Normality of Fe_2SO_4 (0.5N)
0.00399 = Numerical Factors

The percentage organic matter was then obtained as:
O.M = % O.C x 1.724, in which O.M is Organic Matter (%)

2.3 Data analysis

Statistical difference in soil characteristics among soil use types was analyzed by a one- way analysis of variance (ANOVA) using at $p < 0.05$ significant levels. Duncan Alpha was employed to assess mean difference and the association between soil variables.

3. RESULTS AND DISCUSSION

Soil pH and Soil electrical conductivity (EC): The pH values of soil samples ranged from 6.97±0.29 to 6.97±0.76 (Table1).It was found that all the soil samples were moderately acidic in nature. The standards of soil pH and EC scales (Soil Survey Division Staff, 1993), the field soil survey shown that the soil was non-saline and moderately acidic soil. The value of pH and EC at various soil horizon indicate that, there were no significant difference ($p>0.05$) (Table 1) both soil EC and soil pH across the experimental field as illustrated by Figs. 1 and 2. This range (6.97±0.29 to 6.97±0.76) of values in the study are within the range for optimum growing of most sugarcane in Savannah region [9]. However, sugarcane can be successfully grown on soils with a pH value of even 4 as reported by [10]
The EC of soil samples ranged from 0.69±0.03 to 0.73±0.08 dSm^{-1}.The EC values ranged from 0.73±0.08 dSm^{-1}, which is less than the threshold value of 1.7 dS/m for yield reduction in sugarcane production [11]. Thus, these values indicate no salinity risk to the soil, since no value was

found to be close to 4 dS/m, which is the critical limit [7] for indicating a soil to be saline. There were no significant difference ($p>0.05$) (Table 1).

Table 1 PHYSIOCHEMICAL PROPERTIES OF A SOIL AT BLOCKS P (AVERAGE VALUE)

Horizon	Dept (cm)	pH	EC (dSm-1)	Ca	Na	Mg	K	OM	SAR	CEC	ESP
A1	0-60	6.40±0.20[a]	0.64±0.08[a]	22.46±2.16[a]	0.82±0.08[a]	4.20±0.57[a]	0.94±0.26[a]	0.87±0.11[abc]	0.23±0.03[a]	34.12±2.61[a]	2.40±0.36[a]
A2	0-60	6.53±0.38[a]	0.69±0.02[a]	23.07±1.66[a]	0.77±0.21[a]	5.91±1.06[a]	1.18±0.60[a]	1.36±0.54[c]	0.20±0.05[a]	33.19±2.37[a]	2.27±0.50[a]
A3	0-60	6.73±0.59[a]	0.68±0.06[a]	27.32±8.83[a]	0.75±0.15[a]	7.57±0.51[ab]	1.47±0.63[a]	0.98±0.34[abc]	0.18±0.03[a]	39.90±8.78[ab]	1.90±0.17[a]
A4	0-60	6.50±0.10[a]	0.73±0.08[a]	33.82±0.59[ab]	1.74±0.22[c]	12.19±3.03[b]	1.48±0.71[a]	0.53±0.06[a]	0.36±0.05[b]	50.04±3.34[bcd]	3.50±0.56[b]
A5	0-60	6.83±0.49[a]	0.69±0.04[a]	27.04±2.10[a]	1.66±0.10[c]	9.92±3.61[ab]	1.77±1.08[a]	1.19±0.23[bc]	0.39±0.03[b]	44.56±4.58[abc]	3.73±0.58[b]
A6	0-60	6.97±0.76[a]	0.72±0.03[a]	25.23±4.51[a]	1.81±0.16[c]	9.95±2.60[ab]	0.99±0.23[a]	0.70±0.27[ab]	0.43±0.06[b]	44.48±2.77[abc]	4.07±0.40[b]
A7	0-60	6.97±0.29[a]	0.73±0.07[a]	25.95±3.61[a]	1.64±0.17[c]	5.85±1.06[a]	1.35±0.41[a]	0.50±0.09[a]	0.41±0.07[b]	41.74±3.52[abc]	3.97±0.67[b]
A8	0-60	6.33±0.06[a]	0.70±0.01[a]	42.55±14.62[b]	1.25±0.24[b]	12.93±6.97[b]	0.81±0.16[a]	0.88±0.40[abc]	0.24±0.02[a]	61.63±17.29[c]	2.07±0.25[a]
A9	0-60	6.67±0.57[a]	0.69±0.03[a]	30.86±7.39[ab]	1.80±0.16[c]	9.08±3.37[ab]	1.51±0.65[a]	0.59±0.17[a]	0.41±0.04[b]	55.07±8.34[cd]	3.30±0.36[b]

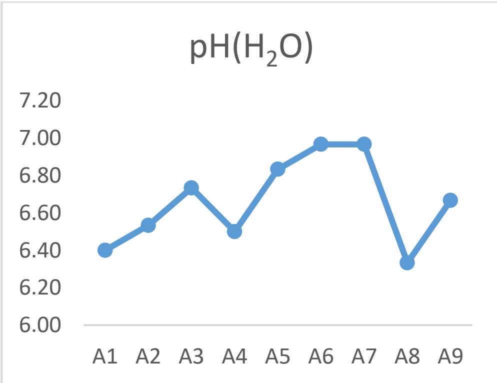

Fig. 3: pH (H_20) of soil at plot P

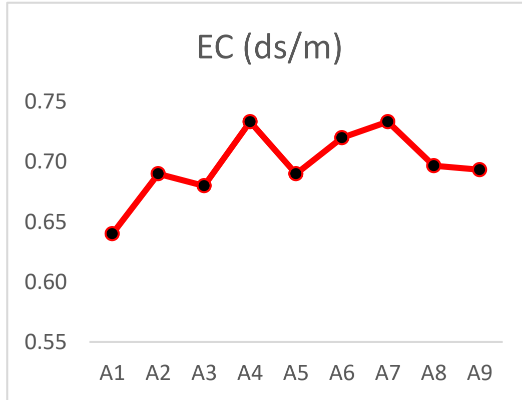

Fig. 2:EC dsm^{-1} of soil at plot P

Exchangeable Sodium: Sodium analysis of the samples showed that, there was significant different (P>0.05) in sodium at soil horizon. The sodium contents of the soil were range between 0.75±0.15-1.81±0.16 cmol+/Kg at the field plot (Table 1)

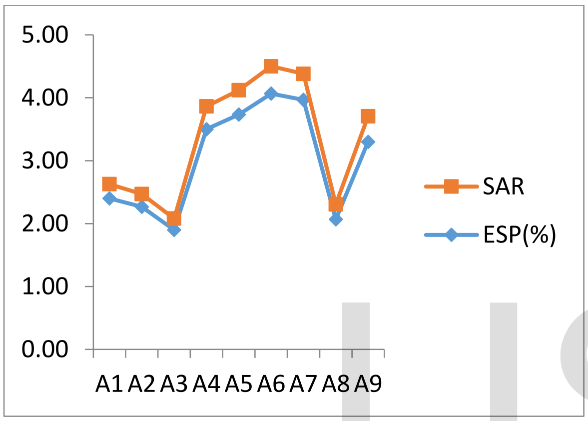

Fig. 4: Soil SAR and ESP at plot P

Soil Organic Matter: Soil organic matter is an important property of soil which increases water content at field capacity, increases available water content in soil and increases both air and water flows rates through Soil Structure, increase microbes thrive to soil, plant damage threat is avoided.

Organic matter level of the soil are ranges of 0.50±0.09-1.36±0.54% (Table 1) and varied significantly (P<0.05) in the location. It showed in the study area soil samples contains sufficient amount of organic carbon. According to [12], If the organic carbon content is <0.50%, the soil is considered as low in carbon and if the carbon content is >0.75%, the Soil is considered very rich in carbon

The highest Soil Organic Matter was recorded at the soil horizon A_2, A_3, A_5, and A_8 (Table 1) which tend to decrease sharply along the soil profile at some locations and mild at some places across the study area (Fig 4).

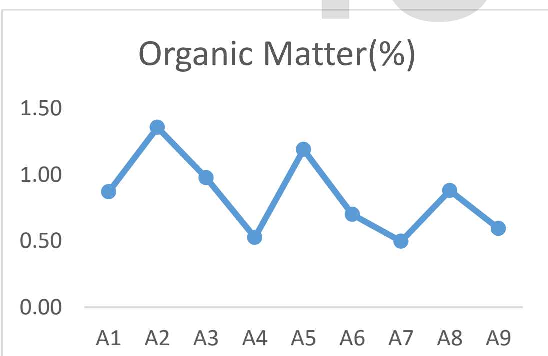

Fig. 5: Organic Matter Content (OMC) of the soil at plot P

Table 2 CHEMICAL PROPERTIES OF A SOIL AT BLOCKS P

					95% Confidence interval			
Parameter	N	Mean	Std	St error	Lower boundary	Upper boundary	Min	Max
pH	27	6.67	0.43	0.08	6.49	6.83	6.10	7.50
EC ds/m	27	0.70	0.05	0.10	0.68	0.72	0.56	0.81
Ca (cmol+/Kg)	27	28.70	8.17	1.57	25.47	31.93	20.02	56.76
Na (cmol+/Kg)	27	1.36	0.47	0.09	1.17	1.55	0.56	1.98
Mg (cmol+/Kg)	27	8.62	3.90	0.75	7.08	10.16	3.56	20.90
K (cmol+/Kg)	27	1.28	0.58	0.11	1.04	1.51	0.67	2.96
OM (%)	27	0.84	0.37	0.07	0.70	0.99	0.39	1.95
SAR	27	0.32	0.10	0.02	0.28	0.36	0.15	0.49
CEC	27	44.97	10.94	2.11	40.64	49.30	30.45	80.56
ESP	27	3.02	0.91	0.18	2.66	3.38	1.80	4.40

Soil CEC: The CEC is a measure of the soil's ability to adsorb (and release) cations. It is highly needed for the estimation of contaminant transport potential and sorption capacity for any soil location i.e. the total number of cations it can retain on its adsorbent complex at a given pH [13].

Ca and Mg are very essential elements for plants optimum performance. It is the most abundant mineral in soil. These element are comparatively needed in small quantity and are known as secondary nutrients [14], both the exchangeable bases were significant difference at ($p<0.05$) on the concentration of exchangeable Ca, Mg and K among the agricultural field P. the value of exchangeable calcium lower boundary of 25.47 cmol+/Kg and upper boundary 31.93 cmol+/Kg potassium with lower boundary 1.04 cmol+/Kg and upper boundary 1.51 cmol+/Kg (Table 2), K is not an integral part of any major plant component but it plays a key role in a vast array of physiological process vital, plant metabolism reactions, translocation of sugar, ranging from lignin and cellulose used for formation of cellular structural components, to regulation of photosynthesis and production of plant sugars that are used for various plant metabolic need. There was no significant ($p<0.05$) different across the soil horizon (Table1).

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