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Effect of Bush Burning on the Cation Exchange Capacity of the Soil in Bali Local Government, Bali, Taraba State, Nigeria.

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Abstract

Bush burning is the intentional setting the land in fire which burns importance microorganism, organic matter and changes the physical as well as the chemical properties of the soil. Cation exchange capacity abbreviation to CEC measures the amount of cations (positively change ions) which can be absorbed by e.g. organic matter or clay mineral and which can be exchanged for cations dissolved in a solution. Four experiments were carried out in the Orchard of Bali Local Government, Bali. The first experiment was meant to see if soil had electrical charge. The second experiment was to find out whether bush burning had an effect on the cation exchange capacity of the soil. The third experiment was to see if the of bush burning on the cation exchange capacity varies with soil depth. The fourth experiment was to see if sandy, loamy and clay soil have the same cation exchange capacity. The result showed that soil had a statistically significant electrical charges ($P < 0.01$). Bush burning had a statistically significant effect on the cation exchange capacity of the soil ($P < 0.01$) in clay and loamy soil, but in sandy soil, ($P < 0.05$). The cation exchange capacity of the soil varied with soil depth ($P < 0.01$).The result had practically affirmed that these three (3) types of soils had different cation capacity of the soil ($P < 0.01$).

Keywords: *Bush burning, cation exchange, climate change and bio physicochemical*

Introduction

Bush burning is the intentional setting the land on fire which burns importance microorganism, organic matter and changes the nature of soil as well as the chemical makeup of the soil. Half of the world soils that have been used as forest are now transformed in to agricultural soil and other function ,and the mechanism that is used for clearing the forest is bush burning. This might affect the physicochemical properties (Bryant et al. 2017).Apart from these, many gases that are considered as greenhouse gases are released into the atmosphere and caused global warming as a result of the depletion of the ozone layer (Jamala et al, 2018). According to McKnight (2016), plants absorb carbon dioxide during photosynthesis, and this reduces the concentration of it in the atmosphere. But, trees are now deforested, the concentration of carbon dioxide increases. This is one of the reason why most of the world are facing the problems of global warming. The Environmental specialists discovered that the fertility of the soil is destroyed and exhausted as a result of burning the soil and more carbon dioxide is released into the atmosphere when plants are burnt and thus subsidizing the diminution of the ozone layer and climate change Wendi, (2011). Cation exchange capacity of the soil, abbreviated as (CEC), refers to the ability of the soil to retain a positively charged element and release them to plant when the need arises. It is one of the methods of assessing or evaluating the soil potential. These positively charged element be potassium (K^+), sodium (Na^+), magnesium (Mg^{2+}), calcium (Ca^{2+}), hydrogen (H^+), ammonium (NH_4) and aluminum (Al^{3+}) . These are regarded as the most ample exchangeable cation in soil. (Adam, JD 2015).

OBJECTIVES OF THE STUDY

The general objectives of this research work is to examine the effect of bush burning on cation exchange capacity of the soil. Specific objectives further highlighted for this study include;

i. To examine if soil has electrical charges..
ii. To examine the effect of bush burning on the cation exchange capacity of the soil.
iii. To examine whether the effect of bush burning on cation exchange of the soil varies with soil depth..
iv. T examine whether sand silt and clay have the same cation exchange capacity of the soil.

METHODOLOGY

Four experiments were carried out in the Orchard of Bali Local Government, Bali. The first experiment was to see if soil had electrical charge. The second experiment was to find out whether bush burning had an effect on the cation exchange capacity of the soil. The third experiment was to see if the effect of bush burning on the cation exchange capacity varies with soil depth. The fourth experiment was to see if sandy, loamy and clay soil have the same cation exchange capacity.

- Material used
- Dug soil profile
- Motorcycle battery
- Exercise book
- Weighing balance
- Pen
- Exercise book
- Digger
- Shovel
- Textural Triangle

PROCEDURE

Different soil samples (sandy, loamy and clay soils) were collected at different location of Bali. The samples were poured into a cylinder and water was filled. After a minute, sandy particle settled at the bottom of the cylinder, followed by silt and lastly, clay particle. A ruler was used to measure each the space occupied by each soil particle. The percentage of each particle was determined and subjected to a textural triangle. After the determination of the classes of the soil samples collection of the soil samples, they were diluted in the rubber bucket. The battery was inserted into the diluted soil samples. Since the battery has positive and negative wire, much of the soil samples were attached to the anode side of the wire signifying the that most soil are negatively charged. Also, different soil samples were burnt and the battery inserted into the rubber bucket to compare the attached soil to the wire and the soil that was attached the wire of unburnt soil. Soil profile was dug and the soils were tested differently for the negativity of the soil. Different soil samples showed a different ability to be retained to positively charged wire. Unburnt soil samples were fifty (50), burnt soil samples were fifty (50), too. The soil profile was 1m only.

Experimental Design

The experimental design used was a randomized block design which consisted of 30 soil samples as treatments and 30 soil samples as controls.

Data Analysis

The data collected were subjected to one way analysis of variance, mean separation was done using the (SPSS) Statistical Package for Social Science, multiple range test. Consequently, the error bar was presented to facilitate interpretation and comparison of results.

RESULTS

On the experiment to test whether soil has electrical charges, the result showed that soil had a statistically significant electrical charges ($P < 0.01$). See figure 1 below.

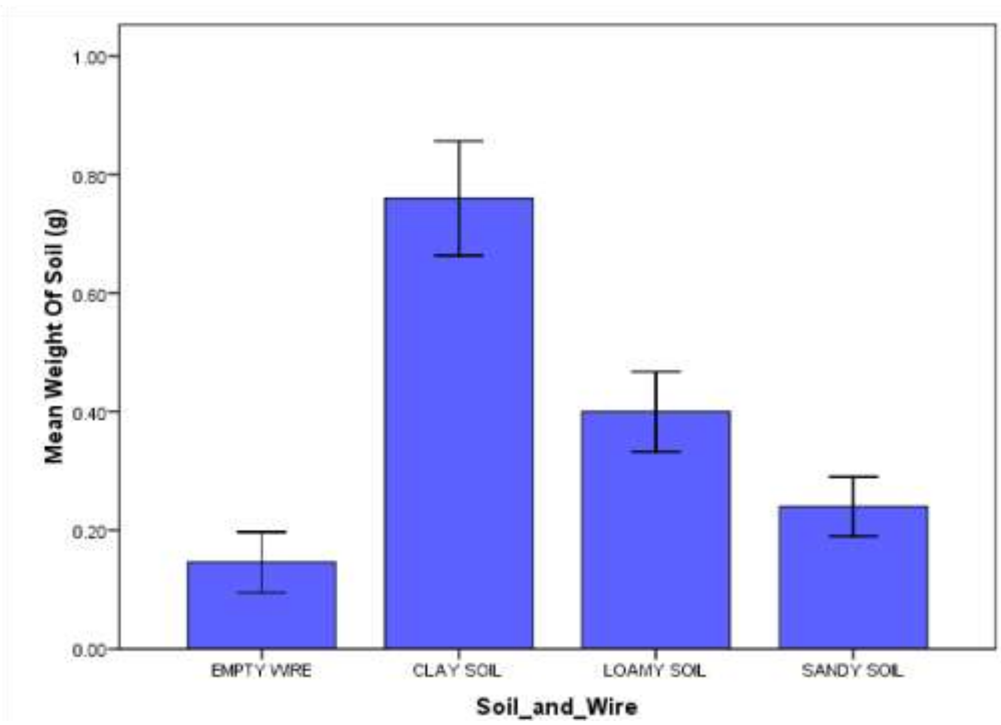

Figure 1. Mean weight of empty wire and different types of soil in which the empty wire was inserted and the standard deviation. The values 0.14 ± 0.07, 0.76 ± 0.13, 0.40

± 0.09 and 0.24 ± 0.06 are means and standard deviations of the empty wire and soils.

On the effect of bush burning on the cation exchange capacity of the soil, this result showed that bush burning had a statistically significant effect on the cation exchange capacity of the soil ($P < 0.01$) in clay and loamy soil, but in sandy soil, ($P < 0.05$). See figure 2, 3 and 4 below.

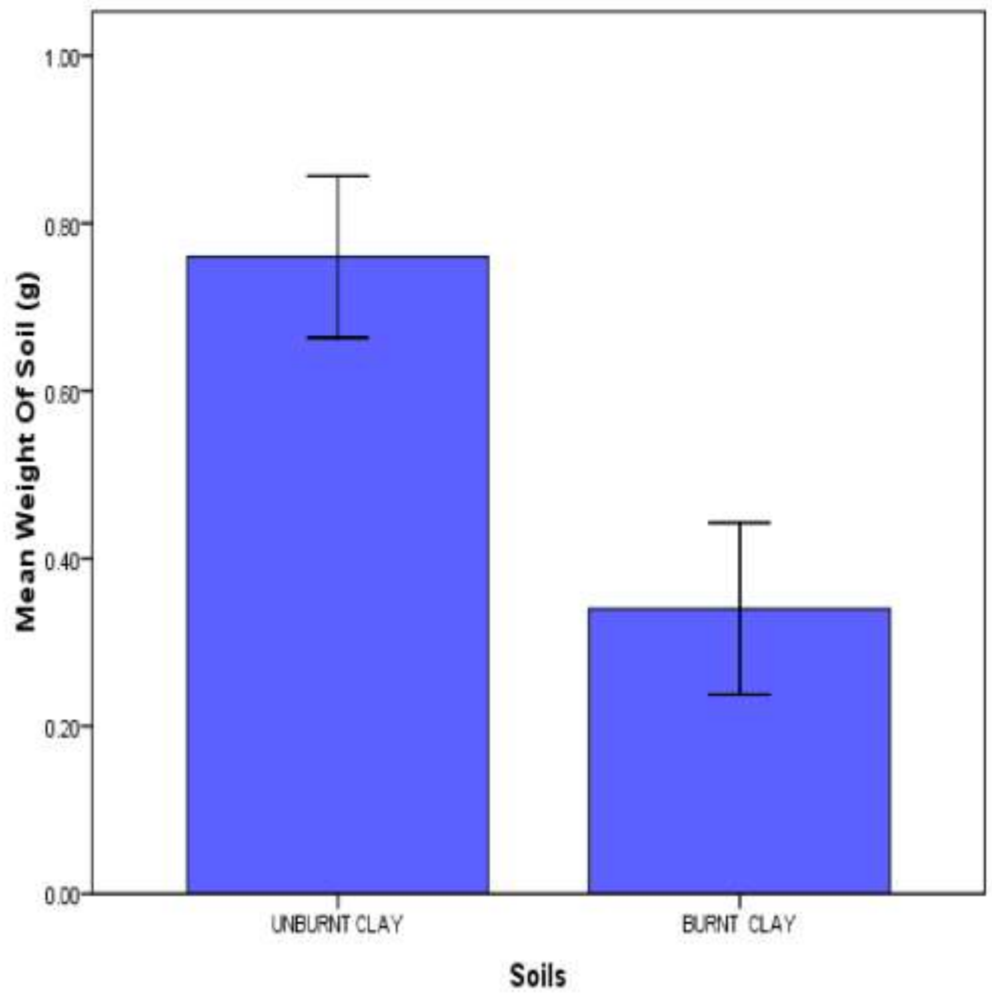

Figure 2. Mean weight of unburnt and burnt clay and the standard deviation. The values 0.76±0.13 and 0.34±0.14 are mean and standard deviation of unburnt and burnt clay, respectively.

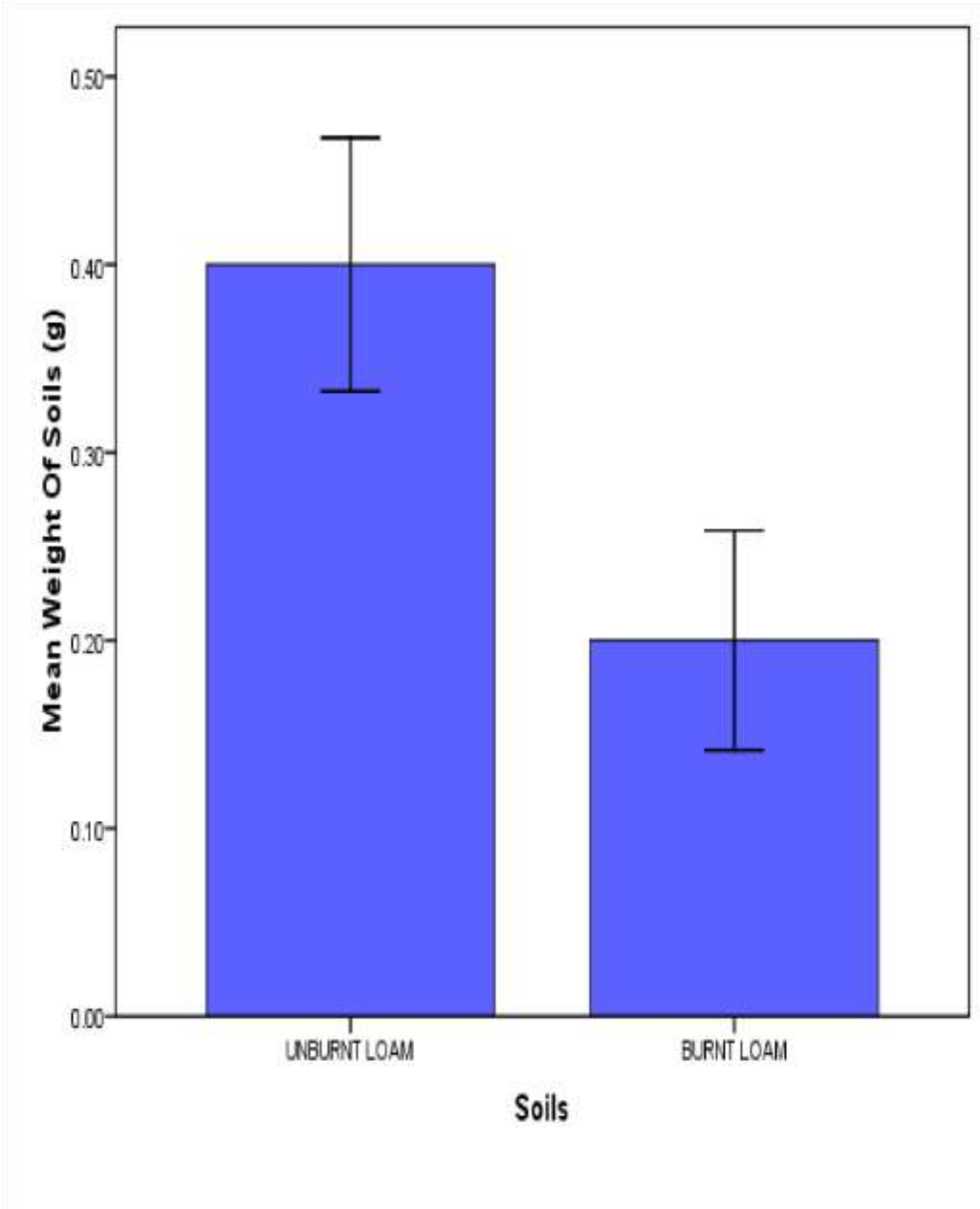

Figure 3. Mean weight of unburnt and burnt loamy soils and the standard deviation. The values 0.40±0.09 and 0.20±0.08 are mean and standard deviation of unburnt and burnt loamy soils, respectively.

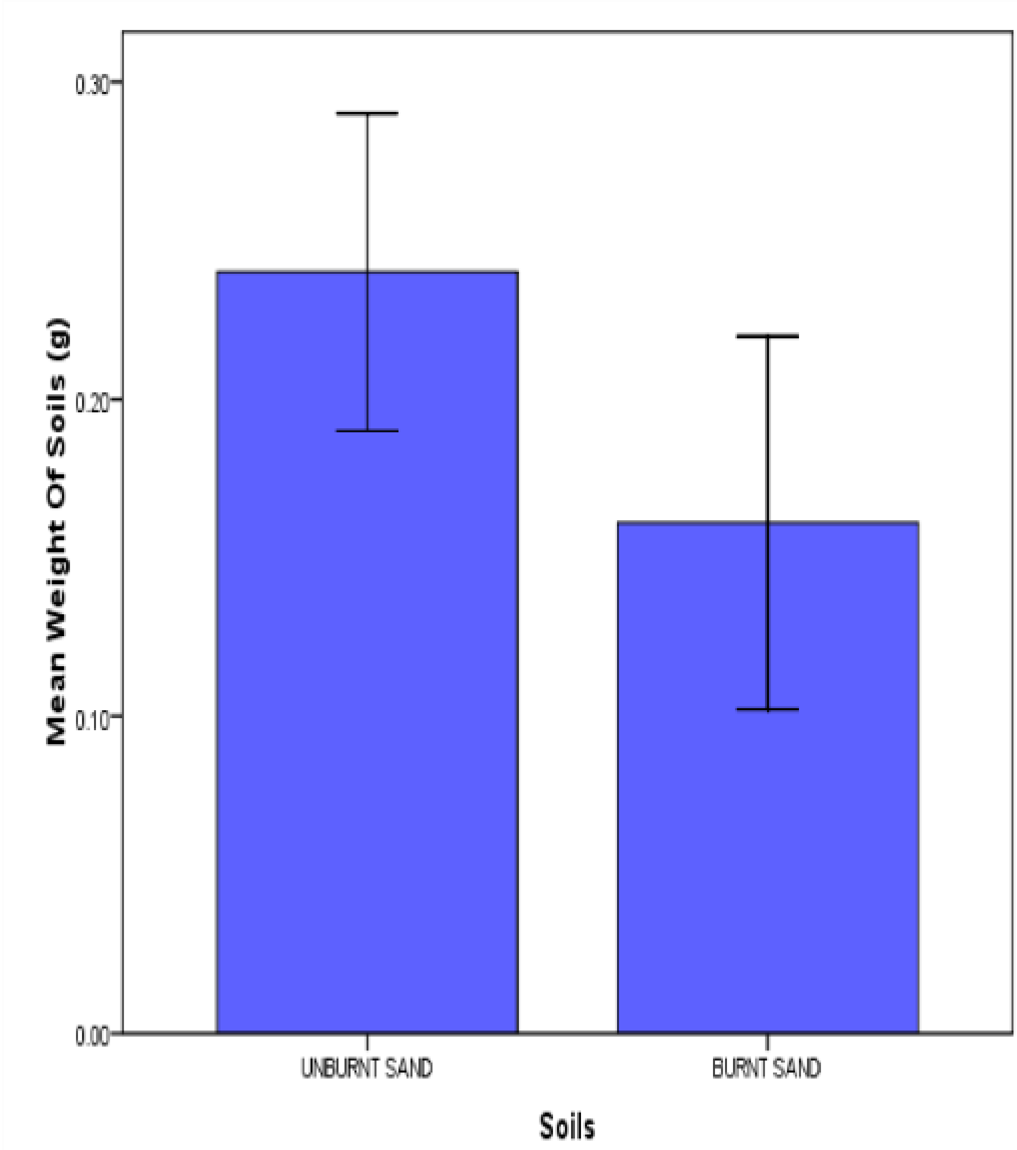

Figure 4. Mean weight of unburnt and burnt sandy soils and the standard deviation. The values 0.24±0.06 and 0.16±0.08 are mean and standard deviation of unburnt and burnt sandy soils, respectively.

On the experiment to test whether soil cation exchange capacity of the soil varies with depth, the result showed that the cation exchange capacity of the soil varied with depth

($P < 0.01$) see figure 5 below.

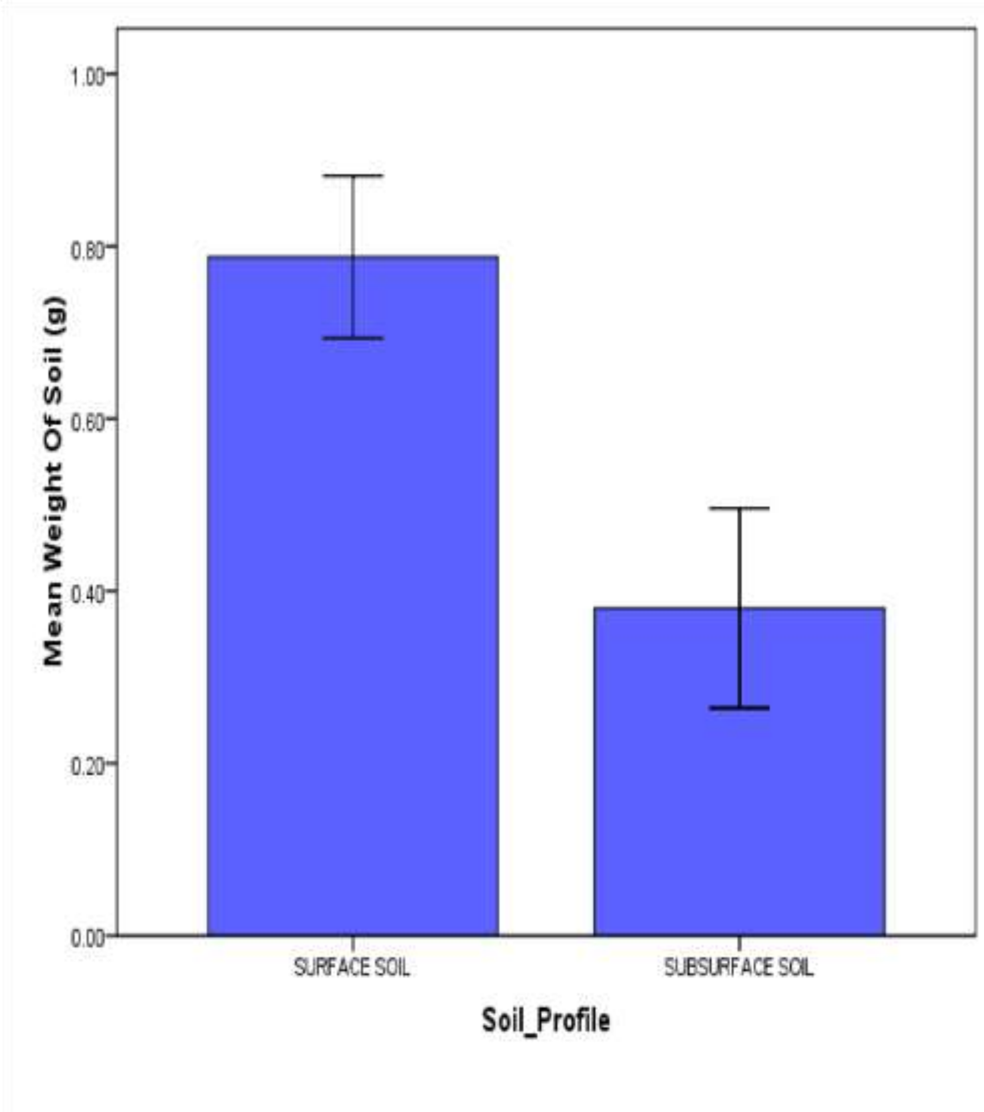

Figure 5. Mean weight of surface and subsurface soils and the standard deviation. The values 0.79±0.11 and 0.38±0.16 are mean and standard deviation of surface and subsurface soils, respectively.

On the experiment to test whether sand silt and clay soil have the same cation exchange capacity of the soil, this result had practically affirmed that these three (3) types of soils have different cation capacity of the soil ($P < 0.01$). See figure 6 below.

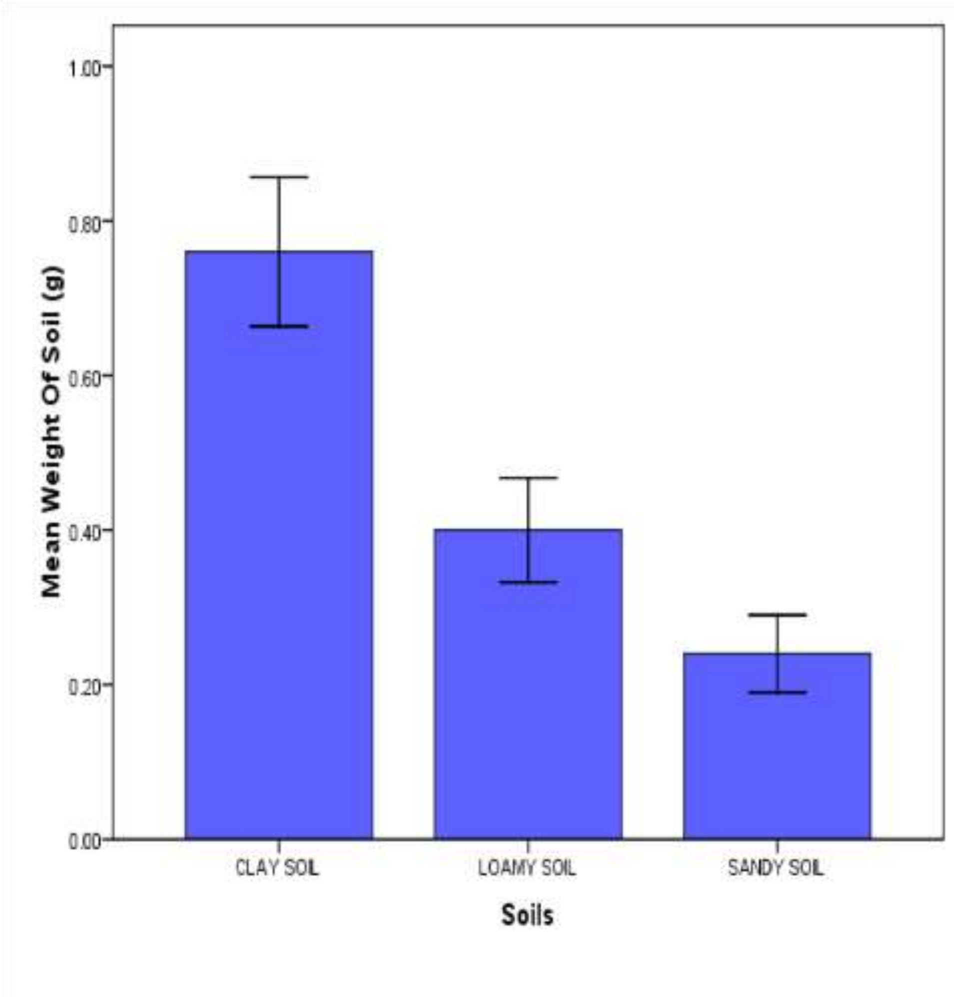

Figure 6. Mean weight of clay, loamy and sandy soils and the standard deviation. The values 0.76±0.13, 0.40±0.09 and 0.24±0.06 are means and standard deviations of clay, loamy and sandy soils, respectively.

DISCUSSION

Production of electrical charges

On the production of electrical charges by the soil, the original hypothesis was soil could not produce electrical charges. But the result of this finding revealed that soil could produce electrical charges, and the production was statistically significant. This finding has a similar result with the result of Bascomb (2014) where he conducted and experiment on the ability of the soil to produced electrical charges and confirmed that soil produces electrical charges. This result is also supported by the finding of Jackson, (2018) where he stated that soil can produces electrical charges after the completion of research on the cation exchange capacity of the soil. According to him, this ability can be affected by fire .But this result is not similar with the result of where he confirmed that soil can produce electrical charges, but the production is no significant. Insignificant production of electrical charges by the soil said by the last researcher might be associated with different methodology used, the condition in which the soil for the analysis was collected and other factors. But under a normal condition, many scientist confirmed that soil can produce electrical charges that can either originate from isomorphic substitution or dissociation of hydrogen ions from organic functional group.

Effect of soil type on the soil electrical charges

On the effect of soil type on soil electrical charges, the original hypothesis was soil type had no significant effect on the soil electrical charges. But according to the result of this research, soil type had a statistically significant effect on soil electrical charges (P < O.O1).This finding is the same with the finding of Wendi 2011 in their zeal to compare the ability of three types of soil to retain a positively charged cations. After the completion of the research, the finding revealed that different types of soils have a different ability to retain positively charged ions. According to them, clay soils have the highest ability, followed by a loamy soil. They explained that the finer the soil , the higher the surface area and the higher the cation exchange capacity of that soil. In the year 2017, Kauffman. conducted a cation exchange capacity study in relation to comparison among the three types of soil, they concluded that a wide variation exist in relation to their ability to retain positively charged ions. This result is 100% supporting this finding. Finally, soil types have statistically significant effect on cation exchange capacity.

Effect of bush burning on the soil electrical charges

On the effect of bush burning on the soil electrical charges, the original hypothesis was bus burning had no statistically significant effect on soil electrical charges. But the result of this research revealed that bush burning had a statistically significant effect on soil electrical charges ($P < 0.01$). This result is not different from the result of Odes, J.M (2019), where an experiment was conducted in order to compare the soil electrical charges of bush burnt soil and un - bush burnt soil, the investigation revealed that bush burning reduced the edges of a negative charges of that soil. The un- burnt soil retained more soil particles because the negative edges of that soil had not been destroyed by fire. This is not the only researcher who supported this finding, but also Meier (2017), conducted a similar experiment and arrived at the same result. But the result of

Bascomb, C.L. (2014), was not similar to this. This different result might be associated with environmental and soil differences. Finally, bush burning had a statistically significant effect on soil electrical charges.

Effect of soil horizon on soil electrical charges

On the effect of soil horizon on the soil electrical charges, the original hypothesis was soil horizons had no statistically significant effect on soil electrical charges. But after the completion of this research, the result stipulated that soil horizons had a statistically different significant effect on soil electrical charges. This result was aided by the finding of Ambe et, al (2015) These researchers conducted various experiment to differentiate the effect of soil horizons on their ability to hold soil electrical charges. Their result revealed that top soil had most electrical charges, followed by sub soil. This is related to more organic matter and more macro and microbial activities on the top soil. These activities help in making soil finer. But as we move down the soil profile, the soil particles become harder and this has negative effect on the size of the soil particles and the colloidal particles. Also, in the recent experiment conducted in 2018 by Jackson, confirmed the authenticity of this research that different soil horizon had a different effect on soil electrical charges. But different environment, nature of the soil particles and other external factors will make the opposite of this result. But under normal situation, this result has no biasness. Finally, the result of this finding is concluding that soil horizons had a statistically different significant effect on soil electrical charges.

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