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Carbon And Carbonates In Soil Fertility

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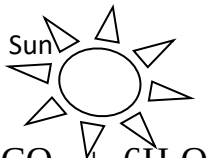
ABSTRACT
The content of carbon and carbonates on a parcel of land was studied to determine its availability. Four closed locations of a piece of the research farm land in the University were marked at intervals of 0-30metres, 30-60m, 60-90m and 90-120metres respectively. This was to ascertain the availability of carbonates that are present in the piece of land. Soil samples at different depths were obtained to the tune of 7-8cm each. The content of carbonates in the soil was determined. The moisture correction factor (mcf) was taken as unity. Observation showed that samples of top soil contain more carbonates than the samples lower in the soil. In all samples of analysis, the content of carbonates in the soil was suitable to promote growth of the crop.
Keywords: Carbon, Carbonates, Photosynthesis, Soil, Fertility.

INTRODUCTION

Carbon is a macro element that is needed by plants for growth and development[1]. Plants take in carbon in solution as carbonates. In the atmosphere, carbon is found as carbon (iv) oxide. The percentage of CO_2 is 0.03% in the atmosphere. Carbon is the major building block of all organic matter[2]. Organic matter which is made from carbon do help to replenish soil nutrients[3]. Carbon dioxide is mostly removed from the atmosphere by a process called ***Photosynthesis.*** Photosynthesis is the process whereby green plants make use of simple inorganic materials of CO_2 and H_2O in the presence of sunlight energy to produce carbohydrates, oxygen is released as a by product[4].

Photosynthesis



$$6CO_2 + 6H_2O \xrightarrow[\text{Chlorophyll}]{\text{Sunlight}} C_6H_{12}O_6 + O_2 + H_2O$$

This natural reaction takes place in two stages known as light and dark stages.

Light Stage Reaction

Light stage involves the photo dissociation of water molecules. The chloroplasts contain the green pigment chlorophyll which is capable of absorbing energy from sunlight.
Water is broken down to hydrogen ion (H^+) and hydroxyl ions (HO^-)

$$4H_2O^* \xrightarrow[\text{chloroplast}]{\text{light}} 4H^+ + 2HO^{*-}$$

The OH^- undergoes reaction to form oxygen and water.

$4OH^* \longrightarrow 2H_2O^* + O_{2(g)}$

The H^+ component is used to reduce CO_2 to form complex organic components of starch and sugar

Dark Stage Reaction

$CO_2 + 4H^+ \longrightarrow CH_2O + H_2O$

The hydrogen ion gains electron in a redox and oxidation reaction to form water and a carbon/water unit. The CH_2O undergoes a polymerization reaction to form sugars and starches.

$$n(CH_2O) \xrightarrow{\text{Polymerization}} \underset{\text{sugar}}{C_6H_{12}O_6} + \underset{\text{starch}}{C_6H_{10}O_5}$$

The final products of photosynthesis are Carbohydrates, oxygen and water.
The atmosphere gains its carbohydrate by burning of fuel like coal and wood others are from volcanoes, respiration by animals and plants,[6] the death, decay and putrefication of plants and animals. Much of CO_2 in the atmosphere may result to a greenhouse effect (excessive heating of the atmosphere) or a global warming of earth's atmosphere[7].

The various process in which carbon dioxide of the atmosphere is used up and later replenished into the atmosphere again is called carbon cycle.

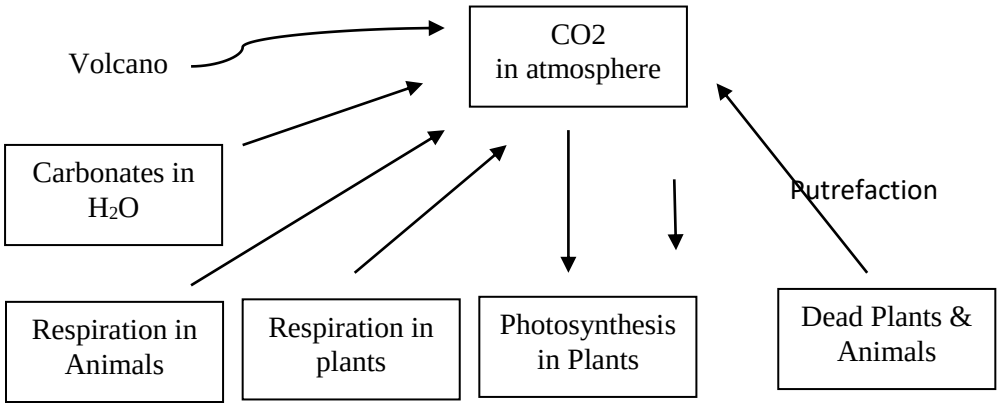


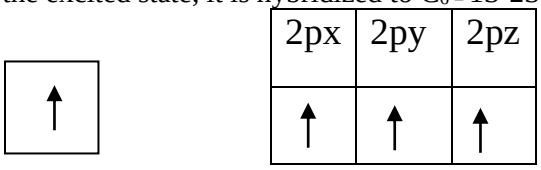
Fig. 1: Carbon Cycle

Chemistry of Carbon

The atomic number of Carbon is 6 and its mass number is 12 in the periodic table. It has three isotopes namely-carbon 12, carbon 13 and carbon 14.

In the ground state, its electronic configuration is $C_6 = 1s^2 2s^2 2p^6$

In the excited state, it is hybridized to $C_6 = 1S^2 2S^2 2P^3$



It is Sp^3 hybridized [5].

This makes carbon able to form with many compounds of hydrogen, oxygen, nitrogen and halogens. It also has the ability to form single, double or triple covalent bonds.

EXPERIMENTATION AND METHOD

Location

The study area is a research farm land located in Rivers State of Nigeria owned by the Rivers State University of Port Harcourt. It lies between latitude 7°E of Greenwich meridian and longitude 5°N, North of the equator.

The climate is wet land of the Niger Delta. It is characterized by the dry season holding at November through March. The rainy season starts from March to October in every year. There is an August break within the wet season. It is usually dry at this break each year.

Determination of Carbonates in the Soil

Method

The soil was obtained and dried to constant weight.

Place 100ml of 30% v/v HCl in a plastic beaker. 5.0g of dried soil was added to the acid. As the soil was added to the acid, effervescence was observed with the air trapped between soil particles and the acid.

Observation

- If effervescence is not heard, it indicates low carbonate
- If effervescence is heard but not seen, the carbonate is less than 2%
- If the effervescence is seen and small particles float to the surface of the beaker, then carbon content is 2-5%
- If effervescence erupts all over the liquid surface, then carbonates content is between 5 and 15%
- Sample foams to the top of the plastic beaker; carbonates content is 15-30%
- Violet effervescence and foaming over the beaker top. Carbonate content greater than 30%

The results obtained from the pits were of values 2% range from 2% mg/L to 30% mg/L. Most carbonates were found on the top soil which range from 15% mg/L to 35% mg/L.

Table 1: Total Carbonates Content in all the Pits

Distance(m)	Depth(cm)								**Mean/** Depth(cm)	
	0-5	5-10	0-5	5-10	0-5	5-10	0-5	5-10	**0-5**	**5-10**
0-30	0.42	0.01	0.44	0.30	0.88	0.30	0.01	0.5	0.43	0.30
30-60	0.40	0.20	0.30	0.20	0.20	0.04	0.40	0.30	0.33	0.19
60-90	0.20	0.10	0.35	0.10	0.40	0.10	0.42	0.21	0.34	0.13
90-120	0.10	0.08	0.44	0.12	0.48	0.12	0.50	0.06	0.40	0.10

Table 2: Carbonates Content in Samples in their Mean Values

Distance(m)	**0-30**		**30-60**		**60-90**		**90-120**	
Depth(cm)	0-5	5-10	0-5	5-10	0-5	5-10	0-5	5-10
Mean(mg/L)	0.43	0.30	0.33	0.19	0.34	0.13	0.40	0.10

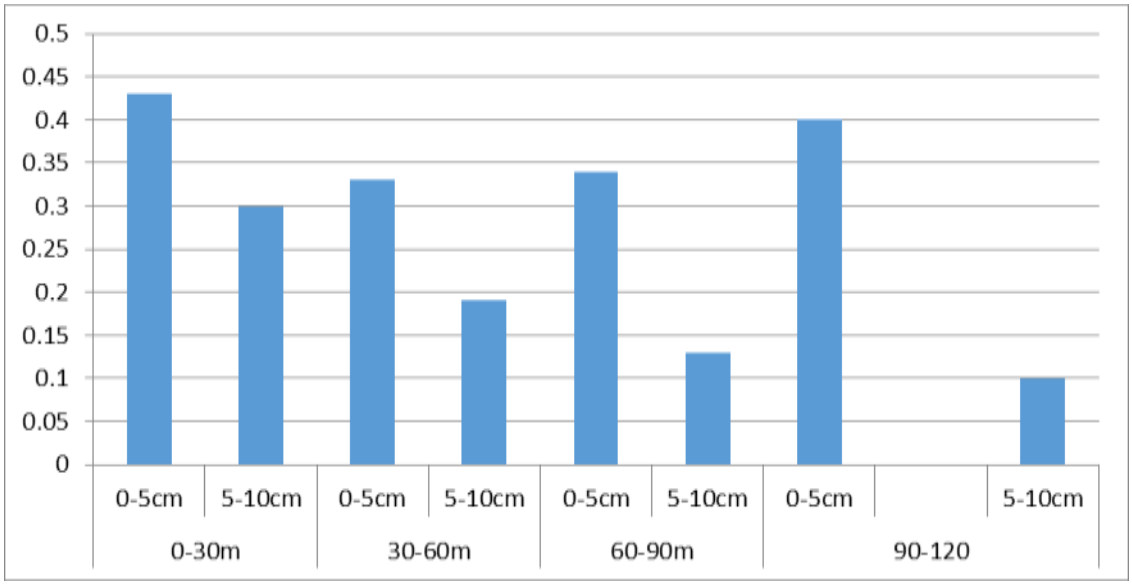


Fig 2: Graph of Carbonates Content in the Soil

DISCUSSION

It is evidently clear that carbonates contents are readily available in top soil than low soil of depth 30.0cm. The top soil has carbonates availabilities of 0.40 – 0.45mg/L in all the samples. The lower soil level holds carbonates of 0.08-0.20mg/L.

Pit 2 recorded low carbonate contents. That piece of land is cultivated yearly and a lot of nutrients must have been removed due to crops consumption of the nutrients. Both peaks in pit 2 are relatively low to show low carbonate contents in that piece of farm land.

The other three farm lands were allowed to remain fallow for a planting season. Thus the high peaks showing high level of carbonates in three pieces of farm lands.

CONCLUSION

Investigation of carbon in the immediate environment and carbonates in the soil was studied. Four pieces of lands studied showed that carbonates in the soil add greatly to the fertility of the crops. The carbonates were experimentally determined by the dry soil and acid effervescence method bubble gas. Carbonates found was at ranges of 00.02mg/L to 0.10mg/L for the deep soil while the top soil had 0.30 to 0.48mg/L in the farm lands.

In conclusion, the piece of land could be left to remain fallow for one to two seasons before planting. This adds more nutrients to the soil than the yearly cultivated farm lands. Artificial supplements of manure and chemical fertilizers can boost the farm nutrients in the issue of acute arable farm lands.

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