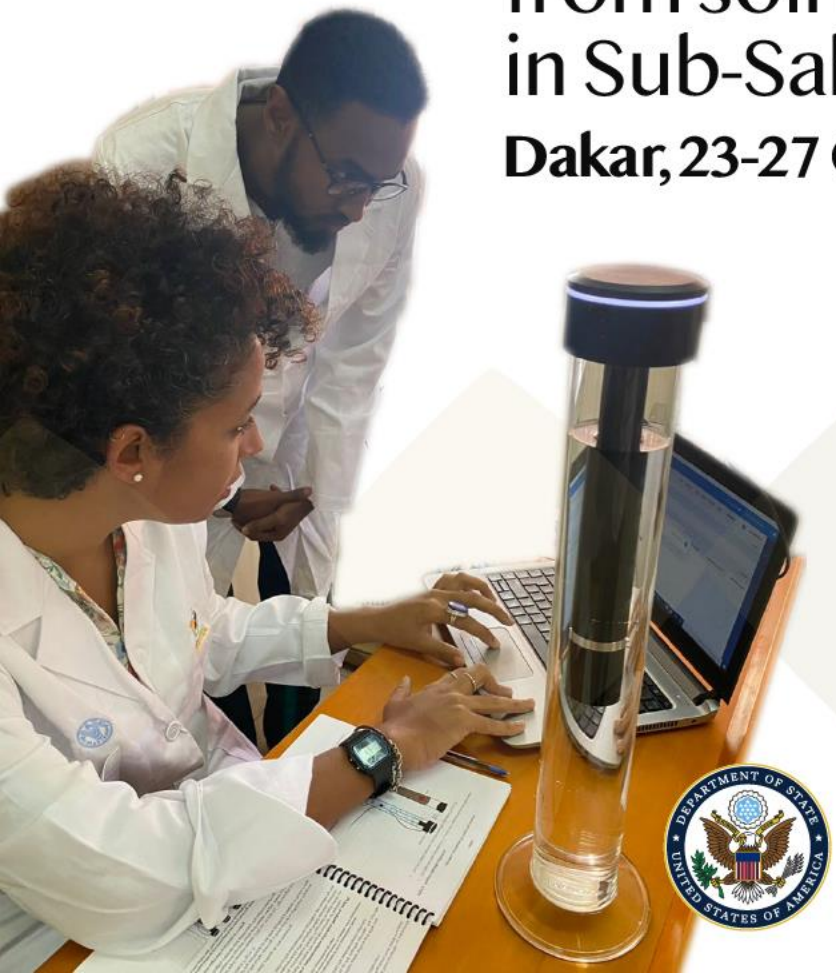
Food and Agriculture Organization of the United Nations

Raising confidence in quality measurements from soil laboratories in Sub-Saharan Africa

Dakar, 23-27 October



SOIL ORGANIC CARBON PRACTICAL WALKLEY-BLACK METHOD

(Colorimetric Method)

Soil Organic Carbon Presentation
Adams Sadick
CSIR-Soil Research Institute
Laboratory Analytical Services

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Introduction

- Soil organic carbon (SOC) is the key element that determines soil quality, fertility and atmospheric carbon dioxide fixation.

- It is the key element of soil organic matter (SOM) that is readily measured quantitatively.

It has influence on:

- Physical
- Chemical and
- Biological properties of soil.

Introduction

- Soil organic matter includes:
- Fresh plant and animal residues
- Humus
- Soil organic matter is calculated from the organic-C content of the soil.
- SOM is assumed to be 58% carbon (SOM = 1.724×SOC)

Principle in Colorimetric Method

- Suitable for all soils except with those where organic carbon is less than 0.2% (<0.2%)
- It is a wet oxidation procedure which follows the reaction below:
- $2Cr_2O_7^{2-} + 3C^o + 16H^+ \longrightarrow 4Cr^{3+} + 3CO_2 + 8H_2O$

In the above reaction:

- $C^o \longrightarrow C^4$: Carbon is oxidized
- $Cr^{6+} \longrightarrow Cr^{3+}$: Dichromate is reduced

Principle in Colorimetric Method

- Measurement of organic carbon is based on the oxidation of carbon in an acidic medium

- Organic carbon is estimated from amount of chromic ion formed after oxidation using colorimetric procedure

Preparation of Soil Sample

- Air-dry the collected sample from the field in an open and ventilated shade and stirring from time to time.
- Grind the air-dried sample to crush the soil aggregate
- Sieve the sample through 2mm mesh sieve to remove gravels, roots, and any crop residues for only the fine particles to remain.
- Keep the sample for laboratory analysis

Apparatus

- Analytical Balance
- Spectrophotometer
- Centrifuge Tube/glass conical tubes
- Volumetric pipettes
- Volumetric flasks
- Graduated pipettes
- Glass rod
- Beaker

Reagents (Colorimetric Method)

- Potassium dichromate, 10% : dissolve 10g in 100 ml de-ionized water.
- Sucrose
- Sulphuric acid, concentrated

Laboratory Analysis of Organic Carbon

- Weigh 0.5g of the prepared soil sample
- Add 2.0ml of 10% potassium dichromate solution
- Add 5.0ml of concentrated Sulphuric acid, allow it to cool down in an insulated sheet
- Add 20ml of deionized water and allow it to stand overnight in a fume chamber

Preparation of Standard Curve

- Prepare a set of sucrose standard as shown in the table below

Mass of OC (mg)	0	1	2	3	4	5	6	7	8
Sucrose STD (4mgC/ml)	0.00	0.25	0.50	0.75	1.00	1.25	1.50	1.75	2.00
Distilled water	2.00	1.75	1.50	1.25	1.00	0.75	0.50	0.25	0.00

Preparation of Standard Curve

- Add 2ml of 10% potassium dichromate to the stands
- Add 5ml of Sulphuric acid, allow it to cool down and wait for 30 minutes inside an insulated sheet
- Add 20ml of distilled water, and allow it stand overnight in a fume chamber

Measurement

- Read the absorbance of the standards at 600nm
- Plot a graph of absorbance against standards
- Make sure that correlation coefficient of the curve is equal to or greater that 0.999
- Proceed with the reading of the samples at 600nm

Calculation

- $OC = \frac{f(A - A_{blank})}{Km} \times 1000$ in g/kg
- Where A = absorbance in the study solution
- A_{blank} =absorbance of blank
- K = coefficient of calibration function
- M = sample weight of the test soil, mg
- f = correction factor

- $OM = 1.724 \times OC \; in \; g/kg$

Health and Safety

- Safety glasses, gloves and lab coat must be worn when handling any chemicals.
- Potassium dichromate: Highly corrosive and a strong oxidizing agent.
- Sulphuric acid: Keep away from naked flames/heat. Always add the acid to the water.

Quality Assurance/Quality Control

ACCURACY TEST

- Participate in interlaboratory proficiency testing program at least once a year.

PRECISION TEST

- Perform replicate analysis at most every 10% samples of a batch. Calculate the %RSD and compare the result with the target precision for the analyte concentration.

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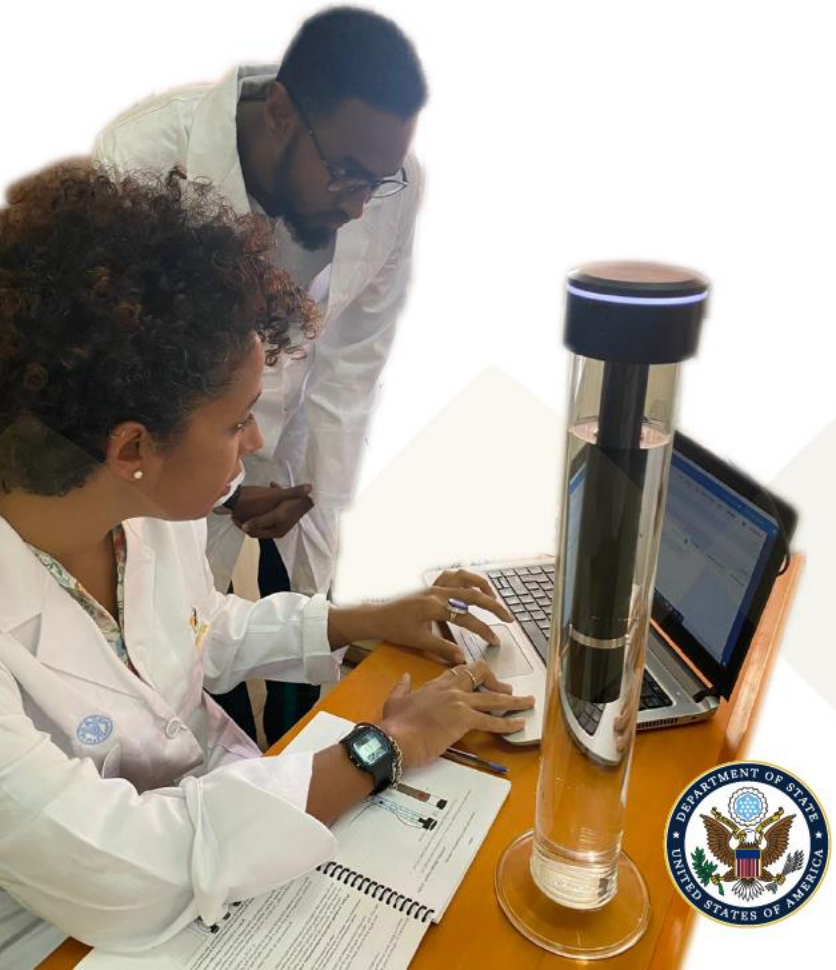

Thank you

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