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ESTIMATION OF SOIL ORGANIC CARBON PERCENTAGE IN ORGANIC FARMING SOIL SAMPLES OF TANUKU REGION, ANDHRAPRADESH, INDIA BY WALKLEY-BLACK CHROMIC ACID WET OXIDATION METHOD

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Abstract— The Estimation of Soil Organic Carbon (SOC) Percentage is done in Organic farming Soil samples from various places in Tanuku Region, Andhra Pradesh, India. It provides all the necessary information about, effect of Organic farming on the concentration of soil organic carbon and also assess the amount of organic matter in soil. The result depends on the quality of soil. The Soil samples were collected systematically from organic farming lands, Sieved the soil samples through 2mm sieves. The determination of SOC is based on the Walkley-Black Chromic acid Wet oxidatiom method. The method measures the amount of carbon in plant and animal remains, including soil humus but not charcoal or coal.

KEY WORDS: Soil Organic Carbon Percentage, Soil Samples, Walkley-Black Chromic acid Wet oxidatiom method

Introduction

Soil Organic Carbon Percentage estimation plays an important role in the carbon cycle, it is also important in global climate change [1, 2].This effects in patterns of different plant species. The amount of carbon that can be potentially stored in soils is vast[3] so carbon sequestration in agricultural soils has been considered as an important choice. In organic farming by changing the soil tillage practices like application of bio fertilizers(crop residue and compost), improved rotations, deep rooting crops increase the soil organic carbon(SOC) content. The aim of present study is not to increase the amount of carbon stored but to find the effect of organic farming on SOC. In this paper the SOC of different organic farming soils were estimated and the statistical analysis is done by determining standard deviation for comparison of different samples.

Study Area

The study area is located in west Godavari district, Andhra Pradesh, India. Soils in this area have mainly black sandy texture. The climatic conditions in study area has three well defined seasons: summer(dry), rainy(wet) and

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Winter(Cold). The study area includes organic farming soils of Chivatam and Velpuru villages.

Methodology

Soil samples from the study area were collected systematically during post monsoon period [4].

Soil sampling :

1. Divided the 100 meters selected field into 10 different homogenous units based on the visual observation and farmer's experience
2. Removed the surface litter at the sampling spot
3. From the depth of 15cm soil by making 'V'shaped cut sample was drawn with the help of plough
4. 10 samples were collected from each village and placed in a tray
5. Mixed the samples thoroughly and removed foreign materials like roots, stones, pebbles and gravels it leads to more accurate assessment of the samples[5].
6. Reduced the bulk to half kilogram by quarterning and compartmentalization
7. Collected the samples in clean and dry containers and labeled with the information like name of the farmer,village,crop growing in the soil,date of collection.

Processing and storage

1. Dried the sample collected from the field in shade by spreading on a clean sheet of paper after breaking the large lumps present
2. Powder the sample by breaking the clods to its ultimate soil particle with the help of a wooden mallet
3. Sieved the soil material through 2mm sieves
4. Repeated the powdering and sieving until only materials of >2mm are left on the sieve.
5. Collected the sieved soil sample in a glass container for laboratory analysis
6. For the determination of SOC the above sample is sieved through 0.2mm sieve.
7. The sieved samples were analyzed for SOC in the laboratory by Walkley & Black method[6].

Walkley & Black method

Principle:

The SOC determination is by Walkley & Black chromic acid wet oxidation[7] method. In this method oxidisable matter in the soil (Carbon) is oxidized (to CO_2) by 1N $K_2Cr_2O_7$, solution. The process is catalysed by the heat generated during the addition of two volumes of H_2SO_4 with one volume of the dichromate. The remaining dichromate is titrated with ferrous sulphate. The titre value is inversely related to the amount of SOC in the sample.

Reagents :

1N Potassium Dichromate

Dissolved 49.040 g $K_2Cr_2O_7$, AR in deionised water, transfered to a 1L volumetric flask and made to volume with deionised water.

Sulphuric Acid 98% w/w

This should be used fresh from the bottle and not left standing in a burette or beaker, as it

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rapidly picks up moisture from the air, It is good until the strength is less than 96%.

0.4N Ferrous Sulphate

Dissolved 112g $FeSO_4.7H_2O$ in 800 mL deionised water containing 15mL concentrated H_2SO_4. Diluted to 1L with deionised water and stored in a dark bottle.

"Ferroin"

Dissolved 1.485g O–phenanthroline monohydrate and 0.695g ferrous sulphate in 80mL deionised water, then dilute to 100mL. Store in a dark bottle away from light.

Procedure

Soil samples have been dried for 1 or 2 days to decrease the amount of ferrous ion to insignificant amount even though fresh sample had high ferrous ion. If ferrous ion is present in soil it leads to high results for dichromate-ferrous sulphate titration. The air dried soil has been grounded and sieved through 0.2mm sieve. 1g of soil weighed accurately into a dry tared 250ml conical flask. To this, 10ml, 1N $K_2Cr_2O_7$ added and swirled the flask gently to disperse the soil in the solution. 20ml of Conc H_2SO_4 is added, immediately swirled the flask until the soil and the reagent are mixed. A 200^0C thermometer is inserted into the flask heated the contents of the flask while swirling on a hot plate until the temperature reached 135^0C. Heat was removed immediately after temperature reached 135^0C as the dichromate will decomposes at 150^0C.The flask kept aside on an asbestos sheet in a fume cupboard to cool slowly. Two blanks (without soil) were prepared in the same way and standardized the $FeSO_4$ solution. After 20-30 minutes when the contents of the flask were cooled, diluted to 200ml by using deionised water, 3 or 4 drops of Ferroin indicator is added and titrated with the 0.4N $FeSO_4$. At the end point solution in the flask turned from greenish colour to dark green colour. At this point $FeSO_4$ was added drop by drop until the colour changes from blue green to reddish grey and then volume of $FeSO_4$ used is noted. Two blank (without soil) titrations were carried out in a similar manner.

Calculations

From the equation

$$2Cr_2O_7^{-2} + 3C + 16H^+ \rightarrow 4Cr^{3+} + 8H_2O + 3CO_2$$

1ml of 1N dichromate solution is equivalent to 3 mg of carbon

The percentage of carbon is determined from the following

Organic Carbon (%) = 0.003g X N X10ml X [1-(T/S)] X 100 ÷W

Where,

N = Normality of $K_2Cr_2O_7$ solution

T = Volume of $FeSO_4$ used in sample titration (ml)

S = Volume of $FeSO_4$ used in blank titration (ml)

W = dried sample weight (g)

The SOC Percentage of the organic farming fields at three villages with 10 samples from each village is calculated by the above formula. The results are presented in the table1.

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Statistical Analysis

Statistical analysis[8] was done for comparing the difference between the percentages of SOC of various organic farming fields from 2 different villages.

- The data is listed for village1 and village2 for 10 samples from each
- The number of samples for each village was recorded (the number of samples for village1 is n_1 and for village 2 is $n_{2)}$.
- Sum of all the SOC values for each village is determined i.e S_1 and S_2
- The mean of each village was calculated (S_1/n_1 and S_2/n_2) = (x_1 and x_2)
- Square of sum of all the SOC values for each village was calculated [$(S_1)^2$ and $(S_2)^2$]
- The variance of the difference between the two means (Sd^2) was calculated as

  $Sd^2 = [(S_1)^2/n_1] + [(S_2)^2/n_2]$
- The Standard deviation was calculated from the square root of variance

Results and Discussion

The percentages of SOC were estimated as 0.37% in Velpuru and 0.5% in chivatam organic farming fields. The Chivatam fields have shown more carbon content than that of Velpuru village.

Table :1 Percentage of Soil Organic Carbon of Organic farming fields from different villages

S.No.	Chivatam Village (1)	Velpuru Village
1.	0.51	0.35
2.	0.47	0.37
3.	0.48	0.39
4.	0.49	0.40
5.	0.52	0.35
6.	0.48	0.36
7.	0.53	0.39
8.	0.52	0.35
9.	0.46	0.38
10.	0.54	0.36
Average	0.50	0.37

Table :2 Statistical Analysis for Soil Organic Carbon Percentage in two different organic farming fields

S.No.	Chivatam Village (1)	Velpuru Village(2)	
1.	0.51	0.35	
2.	0.47	0.37	
3.	0.48	0.39	
4.	0.49	0.40	
5.	0.52	0.35	
6.	0.48	0.36	
7.	0.53	0.39	
8.	0.52	0.35	
9.	0.46	0.38	
10.	0.54	0.36	
S_x	5.0	3.7	**Total (= sum of the 10 sample SOC values)**
n	10	10	**Number of samples in each village**
S_x/n	0.5	0.37	**Mean x (= Total / n)**
$(S_x)^2$	25	13.69	**Square of the total**
Sd^2	0.00068	0.00032	**Variance Sd^2 (= [Ɛ $(x_i - x)^2/n$])**
Sd	0.026	0.017	**Standard Deviation Sd = Square root of Variance**

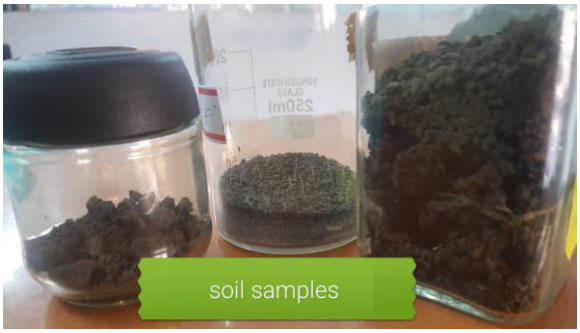

Fig1. Soil samples collected containers

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Fig. 2. Dark Green Coloured reduced dichromate by $FeSO_4$

Fig.3. Soil Sampling

Summary

The present paper deals with the estimation of percentage of SOC in organic farming fields of Chivatam and Velpuru villages located in Tanuku region, west Godavari District, Andhrapradesh, India. It is clearly evident that organic farming effects the SOC and also observed that Chivatam fields have shown more carbon content than that of Velpuru village. The SOC conservation measures should be taken in velpuru village.

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