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Formulation of Organically Enriched Soil Media and Analysis of Organic Matter (Carbon): A Biomaterial for Sustainable Agricultural Practices

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Abstract: ***Sustainable Agricultural Practice plays integrated role by increasing the efficiency of soil. Such agriculture practice is followed by various methodologies with the use of biodegradable organic material. This biomaterial enriches the soil by increasing the components like Carbon [C] and Nitrogen [N]. Organic rich quality farming practice ensures oneself with adequate profit causing no harm to the environment and boosting soil fertility as required for plant growth. Thus maintaining the sustainability of soil as a media to be used for a next cycle of cultivation. Use of hazardous chemicals leads to a dropdown in soil fertility with decrease in organic matter further affecting a quality of crop produce. Hence, tremendous need for biodegradable materials to increase quality farming and crop product has become an utmost necessity in the field of research and development. This research paper aims to study soil media when mixed with suitable biodegradable organic materials. An experimental study of formulation with a mixture of different organic materials in-order to prepare a suitable biomaterial. This biomaterial is treated on soil and analyzed for its pH and increase of organic matter in soil. The research concludes a potential increase in organic matter leading to the stability of soil developing a potential for growing crops under sustainable agricultural practices.***

Keywords: sustainable agriculture, organic matter, biomaterial, formulation

1. Introduction

An agriculture able to continually provide food and other resources to a growing world population is of crucial importance for human existence and hence for human activity. (S Velten, J. Leventon *et. al.*, 2015). Present status in agriculture sector has been facing a problematic situation due to the improper management and high application of inorganic and chemical fertilizers in soil. Due to such applications, a nutrient availability of soil is lost. Also an adverse change in climatic conditions disturbs soil fundamentals. These complications create a threat of critical issues in future developmental methodologies of farming practice. However, agriculture centralize 'soil' as an integral part to support as a basic media for plants and innumerable helpful microorganisms complete process. Variety of components like underground living fauna, microflora, partially decomposed plant and animal residues and humic substances forms a vital sources of nutrients that are found in soil and these components boost the growth of crop. The agricultural technologies need a shift from production oriented to profit oriented sustainable farming**. (**Someshwar B., 2012).

Increase in technological innovations with incorporation of various methodologies efficient for the environmental growth is needed to be carried out so as to fulfill the demand in terms of requirement. A way towards best solution is precisely seen in 'Sustainable Agricultural Development'. Thus, sustainable agriculture is an "integrated system of plant and animal production practices having a site specific application that will, over the long term: (a) satisfy human food and fiber needs; (b) enhance environmental quality; (c) make efficient use of non-renewable resources and on-farm resources and integrate appropriate natural biological cycles and controls; (d) sustain the economic viability of farm operations; and (e) enhance the quality of life for farmers and society as a whole." (U.S. Farm Bill., 1990). Organic biodegradable materials have ability of decomposing materials with help of microorganisms present in the soil. Such materials lead prior increase of natural organic matter components known as macro-elements consisting of Carbon(C), Oxygen (O), Hydrogen (H) and micro-elements consisting of Sulphur (S), Nitrogen (N), Phosphorus (P), Potassium (K), Magnesium (Mg) and Calcium (Ca). Elements though present in small amounts are required, from view-point of Soil fertility management, Water holding capacity, increase in ground water level, maintenance of healthier pH for cropping system. Therefore, Organic matter leads in resolving the nutrient funds in plant-available forms upon decomposition. In order to maintain the nutrient cycling system, the rate of addition of organic matter equals the rate of decomposition as per the uptake of nutrients by plants. This states that the rate of uptake of organic matter by plants is directly proportional to the rate of decomposition.

The research aims on Formulation of organically enriched soil media by use of biodegradable mixtures in various proportion. This formulation, untreated soil sample and treated soil sample was tested to determine pH and the quantitative estimation of organic matter of Soil carbon by Walkley and Black, 1934, also called as Wet method was carried out. The % organic carbon is calculated along with necessary conversion to determine the presence of organic matter using conversion factor. Conversion can range from 1.72 to 2.0 depending on the source of the materials for the organic matter (Murphy B.W., 2014). In practice the value of 1.72 is used (Nelson., Sommers., 1996; Baldock., Skjemstad., 1999). For more precise work only the values of soil organic carbon is used (Murphy. B.W., 2014). Most soil

contains 2-10% of organic matter which is rich in carbon bound compounds in major proportion. Using Emerson crumb test, Greenland *et.al* (1975) found that Soil organic carbon(SOC) < 2%, soil aggregates were considered unstable, moderately stable at 2-2.5% and very stable at SOC > 2.5% (Evelyn S. K. *et. al.*). This research paper edifies the amount of Organic matter present in Untreated soil, treated soil by mixture of Organic formulation and Pure Formulated Organic material known as a **"Biomaterial."**

2. Materials and Methods

A dried Biodegradable source such as vermicompost: cow dung: horse litter: cow urine: urad dal powder: dried yogurt: semi dried neem leaf powder were mixed in proportion of 5:5:2: 3:4:3:4. The formulated dry mixture i.e. Soil**:** Organic mixture added in a proportion of 3:2, named as treated soil. Soil sample without any addition of external source was considered as untreated soil. A sample of pure formulated organic material soaked overnight was considered for analysis. Experiment of samples was carried in triplets.

1) Determination of pH of Untreated soil, treated soil and formulated organic material sample
2) Quantitative Estimation of Organic Matter of the untreated soil, treated soil and formulated organic material sample by Walkley and Black's Method (Wet Method).

Determination of pH of Untreated soil, treated soil and formulated organic material sample

500mg of untreated soil, treated soil and pure formulated organic material sample was taken in three separate beakers of 100ml. To each beaker, equal amount of Barium sulphate and 15 ml of distilled water was added. The solution was allowed to stand until a clear supernatant fluid was obtained. The solution was then filtered by Whattman's filter paper no. 41 and pH of the solution was determined by the pH meter.

Quantitative Estimation of Organic Matter of the Untreated soil and treated soil by Walkley and Black's Method.

Walkley and Black's method also known to be as Wet method is used to determine the percentage of organic carbon in given sample. This methodology consists a use of various chemicals that determines the amount of organic carbon in terms of percentage. The chemical like $K_2Cr_2O_7$ that acts as oxidizing agent in the presence of strong acid like Conc. H_2SO_4. It oxidizes the organic carbon. However, excess amount of $K_2Cr_2O_7$ is then titrated against 1N Ferrous ammonium sulphate using Diphenylamine indicator. Orthophosphoric acid prevents the interference of oxides of nitrogen and other minerals. Alison factor 1.72 is used for calculation to determine the organic matter and other constant used is 1 ml of solution = 0.003gm of Carbon.

3. Results and Discussion

1) Determination of pH:

Untreated soil sample pH was found to be 3.5
Treated soil sample pH was 6.1
Formulated Organic material sample pH was 6.8

- Untreated soil pH was found to be more acidic, while treated soil showed an increase in pH making it suitable for cropping system.
- The pH of formulated organic material sample was observed nearly close to neutral pH as per the requirement of presence for an organic matter in a considered sample.
- **Fig 1.1***

2) Quantitative estimation of Organic matter

Volume of 1N Ferrous ammonium sulphate used for titration of Blank (V_1) =14 ml
Volume of 1N Ferrous ammonium sulphate used for titration of Untreated soil sample (V_2) =11 ml
Volume of 1N Ferrous ammonium sulphate used for titration of treated soil sample (V_3) = 3 ml
Volume of 1N Ferrous ammonium sulphate used for titration of Formulated organic material (V_4) = 0.5 ml

$$\% \text{ Organic carbon in soil sample} = \frac{V_1 - V_2}{W} \times 0.003 \times 100$$

- Percentage organic carbon in Untreated soil sample was found to be 1.8%
- Percentage organic carbon in Treated soil sample was found to be 6.6%
- Percentage organic carbon in Formulated organic material was found to be 8.1%

- Organic carbon percent was found to be least in untreated soil sample while a treated soil sample contained showed efficient rise in Organic carbon percentage by following a reference value parameter of SOC >2.5% as suggested in a research of Evelyn *et.al.*
- Formulated sample showed highest percentage Organic carbon
- **Fig 1.2***

❖ Organic matter in the given soil sample = %Carbon x Alison factor

Organic matter in 0.500gm

- Organic matter in untreated soil sample = 0.030gm
- Organic matter in treated soil sample = 0.110gm
- Organic matter in Formulated organic material = 0.139gm
- **Fig.1.3***

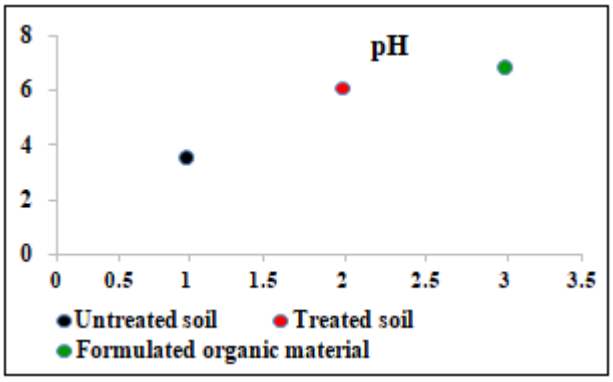

Figure 1.1

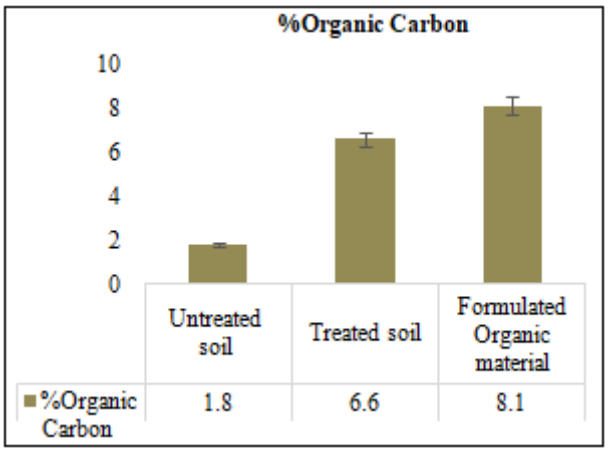

Figure 1.2

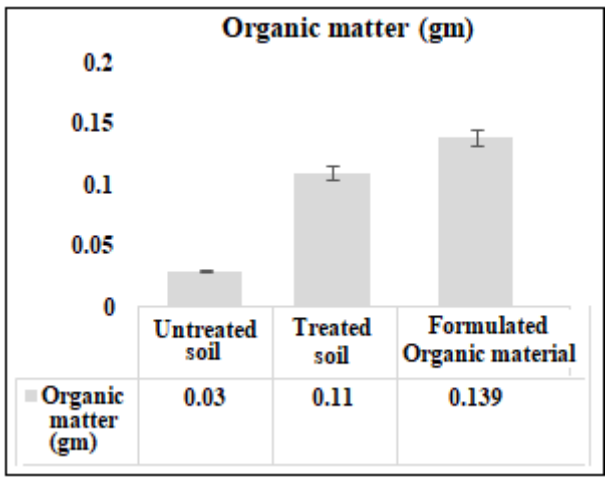

Figure 1.3

4. Conclusion

Untreated Soil sample shows pH3.5; this specifies its prominence of acidic nature not suitable for growing crop. The pH of treated soil sample by a mixture of Biodegradable organic material improves pH by 6.1; while pure form of Formulated Organic material pH is observed to be 6.8 hence, it concludes an efficient increase in the pH of soil, making it stable for production of crop.

Percentage Soil Organic Carbon for 500mg of untreated soil is 1.8% which is lesser than 2% as stated by Evelyn S.K. *et. al.* Hence the soil is Unstable for growing crop. While the treated Soil; for % Soil organic Carbon is 6.6% which specifies its stability for farming purpose since greater than 2.5% as stated by Evelyn S.K. *et. al.* However, the pure Formulated Organic Biomaterial shows 8.1% of Organic Carbon. Therefore, an increase in Natural Organic carbon due to utilization of 'Biodegradable Organic material mixes' creates the efficiency of soil by making it suitable for cropping.

The Organic matter in a Formulated Biodegradable material mixes shows 0.030grams in untreated Soil while that of Treated Soil sample shows 0.110 gm of Organic matter and the pure formulation of Organic Biodegradable material shows 0.139 gm of organic matter. A remarkable rise in Organic matter is observed with increase in the percentage Organic Carbon.

Treated soil of 500mg shows the result of 110mg of organic matter of Carbon. Therefore, it specifies 100gm of soil sample when treated with this formulation; it will result in 22gm of organic. Similarly; 1kg of soil will result in 220gm of organic matter further followed by 22 kg of organic matter results in 100kg of soil. It is concluded nearly $1/4^{th}$ of the mass of soil is filled up with organic matter of Carbon. This states the quality of product without any use of chemicals giving long term benefits in agricultural practices by rising the levels of water holding capacity, soil microbes and other ecological diversity of the atmosphere.

Experimentation completed states the Efficiency and effectiveness of Formulated Biodegradable Biomaterial having greater impact in the soil which forms a combination of best suitable Soil Media under 'Sustainable Agricultural Practices'. It's Richness to sustain the soil with ***zero harmness*** and ***pure natural growth*** for Organic Farming aspiration suits best to name it as **"Jaiv-Samvardhan"** known for its pure Organic property called as **"Jaivik"** and fruitfulness of far-reaching healthy nutritious crop growth called as **"Samvardhan".**

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