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Study And Analysis Of Agar Added Gravelly Soil

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Abstract
The chemical properties of Gravelly soil such as CEC, pH, EC and soil Basic Exchangeable Cations (BEC) such as Ca, Mg, Na, K and physico chemical properties such as Soil Organic Matter (SOM), Soil Organic Carbon (SOC) and physical properties of a Gravelly Soil with and without addition of Agar are estimated. Cation Exchange Capacity (CEC) of Agar Powder added Gravelly soil changes with physical and chemical and physico-chemical properties of soil and measuring the CEC values. The physical and chemical and physic-chemical properties of Gravelly soil sample are correlated using statistical analysis Pearson Correlation. The study was carried out on Thiruvannamalai District, Tamil Nadu, India.
Key words: *Physico-chemical properties, Gravelly soil, soil quality, Agar powder.*

1.INTRODUCTION:

Managing soil organic carbon (SOC) is crucial for restoring soil quality in tropical soils [1]. The ideal soil would capture plenty of air and water for plants to drag together and store it in enough pore space for easy root penetration. In addition to being beneficial for the development of soil structure, soil organic matter (SOM) is necessary for the cycling of nutrients. The soil's CEC determines nutrient exchange capacity, nutrient uptake, and consistency, which effect WHC and aeration, respectively.

SBD is a fundamental soil attribute that is heavily influenced by the amount of organic matter in soils, the mineral content, and porosity. Many researchers obtained the correlation between Soil bulk density and Soil organic matter contents of soil samples and obtained a strong relationship between them.

Soil CEC regulates several aspects of soil fertility, including physical characteristics, plant nutrients, water-holding capacity, and so on. Soil particles absorb more nutrients than sand or silt particles because they have a much larger surface area for adsorption.

The air in the pore spaces (aeration) of a well-structured, drained soil contains around 20% oxygen by volume, which is comparable to the quantity of oxygen in the atmosphere (20.5%). Soil CEC is the total number of Basic Exchangeable Cations (BEC) that a soil can contain, and the exchange sites can be pH-dependent or permanent, depending on the soil type. Electrical conductivity (EC) is a measurement that connects with soil parameters and influences properties such as crop productivity.

Organic matter in the soil enhances soil structure and encourages nutrient cycling. The ideal soil contains high levels of organic matter, mineral nutrients, and adequate aeration. Increased water retention capacity leads to enhanced crops development and growth. Crop progress and growth rely heavily on soil variables such as pH, Cation Exchange Capacity, and nutrient convenience. Soil physical parameters such as water holding capacity and Soil bulk density are crucial for crop productivity. [2-6]

Organic matter, mineral matter, and soil porosity primarily constrain the dynamics of soil physical qualities mentioned above. Numerous studies have found a favourable correlation between SBD and SOM levels in soil.[3]. SOM is a crucial soil component that improves soil structure, water-holding capacity, and nutrient availability. Organic matter provides ideal habitat for a diverse range of soil fauna and microflora, all of which contribute significantly to soil health and productivity. SOM is extremely sensitive to changes in land use and management, soil temperature, and moisture.[7]

The Keen- Rackzowski box method was utilized to ascertain the physical properties of the soil, including its bulk density, porosity, and particle density. [5,6]. They are important markers of soil quality and have an impact on a number of soil functions. The persistence of nutrients in the soil is guaranteed by these organisms. Successful agriculture requires the management of these nutrients through the sustainable use of soil resources. [8].

Studies have demonstrated that the physical disturbance (structure) of the soil, its pH, and other chemical characteristics, in addition to environmental factors like temperature, moisture, and CO2 levels, are important determinants of the structure of the soil microbial community. [9-12].

Mineralization, oxidation, leaching, and erosion are a few of the processes by which land use and soil management techniques can affect soil nutrients [13, 14]. This could have an impact on soil fertility by influencing the existence and activity of soil microorganisms. For example, frequent intensive tillage practices in continuously cultivated soils may cause an increase in the mineralization and breakdown of available nutrients, potentially causing these soils to lose nutrients.

Soil CEC is the total of the Basic Exchangeable Cations (BEC) that a soil can hold and the exchange sites are either pH-dependent or permanent depending on the nature of soil. Many researchers obtained the correlation between SBD and Soil Orgonic Matter [25] contents of soil samples and obtained a strong relationship between them. Soil CEC influences many soils' inherent fertility such as physical properties, plant nutrients, water-holding capacity, etc.

In order to evaluate soil carbon build-up, changes in soil physical and chemical properties, and their positive and negative interactions under laboratory conditions, the current study used agar powder mixed with Gravelly soil in various ratios.

MATERIALS AND METHODS:

Soil samples were collected from Tiruvannamalai district for analysis of physical and chemical properties. While collecting soil samples the upper layer of vegetation, surface litter, stones stubble if any were cleared away and then layer of soil immediately below (0-15m) was collected in polythene bag This study explores the influence of agar (highly purified Agar powder) application on soil organic carbon and cation exchange capacity and their interaction. The present study was conducted using Agar powder mixed with Gravelly soil in order to assess FTIR, SEM and EDAX analysis.

The study was conducted in chitthathur village, Thiruvannamalai district of TN. It is located at an altitude of 90 m amsl, and lying between 12° 55' 55.4268" N and 79° 20' 0.4776" E. The mean maximum and minimum temperatures vary between 36°C and 24°C (Figure 1). The highest temperature ever recorded is 37.8°C and the lowest is 23.8°C. On an average, the district receives 739 mm of rainfall in a year – 272.1 mm rainfall from the southwest monsoon (July–November) followed by high rainfall of 398.3 mm from the northeast monsoon (October–December).

The pH and electrical conductivity of soil samples were determined in 1: 2.5 soil and water suspension. The SOM was obtained from estimated SOC using the conversion equation SOM = 1.53 × SOC.

To determine the soil physical properties such as bulk density, porosity and particle density, the Keen–Rackzowski box method was employed [14,15]. Soil nutrients such as calcium and magnesium, and CEC were determined using Cohex method; sodium, potassium using flame photometer, and SOC using Walkley [23]and Black method [16,17]. The red soil CEC was calculated using the relation

CEC (centi-mol+ /kg) = Exchangeable (Ca++ + Mg++ + K +) factor value (1.0

Figure 1. (a) Map of Study Area

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Result and Discussion:

FTIR Analysis

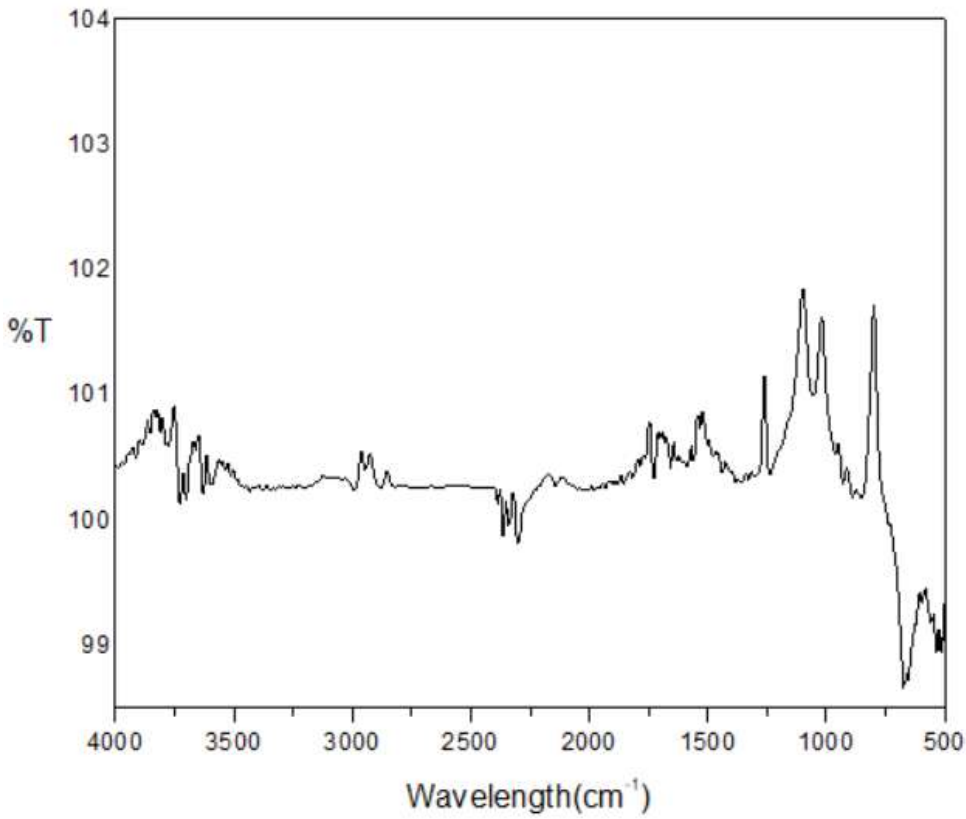
FTIR analysis employs and substantiates the presence of agar in the gravelly soil and the main vibration of orgonic molecules occurs in the IR region and could be studied in the FTIR spectra overtones and

s.no	Wave number	Band type	Functional groups
1	2302	H2O	water
2	1600	C-O Stretching	Alcohol
3	1073	C=O-N	Alkali-amide
4	674	C-C Bending	Alkyl

combination bands in FTIR due to organic matter effect form the stretching and bending of various functional groups such as C-O and C-H also. The agar powder after added along with the soil was shown by FTIR analysis which is presented in the fig (2).

The IR spectrum of gravelly soil the sample shows a band at 2302cm-1[23], which indicates the presence of H20 stretching of water, and a band at 1600 cm-1 represents C-O stretching of alcohol presence in agar, which is conformed, and a band at 1073 cm-1 indicates C-H bending of alkali amide present in agar. Also, the weak band at 674cm-1 may be due to C-C bending of alkyl, as shown 3 Figure 2. FTIR Spectrum in fig. (2).

Table 1. FTIR spectrum of Gravelly soil before and after the addition of agar



SEM Analysis:

The scanning electron microscope (SEM) images in Figure 3 indicate that the mean diameter of Agar powder is about 30 μm and that the shape is irregular. Also, mean diameter of Gravelly soil and Agar powder added Gravel soil is about 10 μm. SEM image of Gravelly soil clearly shows that it has more of macro particles and macrospores, which are directly responsible for low WHC and aeration.

SEM image of Agar powder mixed Gravelly soil shows smaller particle size and more number of micropores[15]. This may due to the small particle size of Agar powder . The fine particles of Agar powder enter into the cavity of the macropores and reduce the pore size, which eventually rises the microspores in the soil. Agar powder mixed with Gravelly soil also rises the WHC and aeration[15] status of the soil, which is mainly due to the presence of more micropores in the Agar powder applied Gravelly soil.

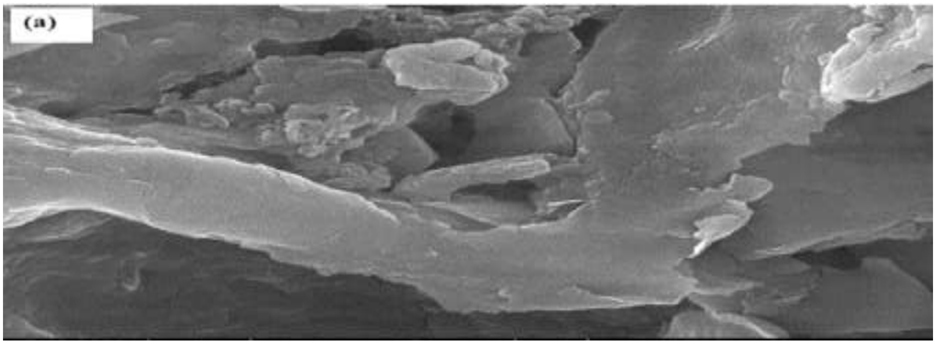
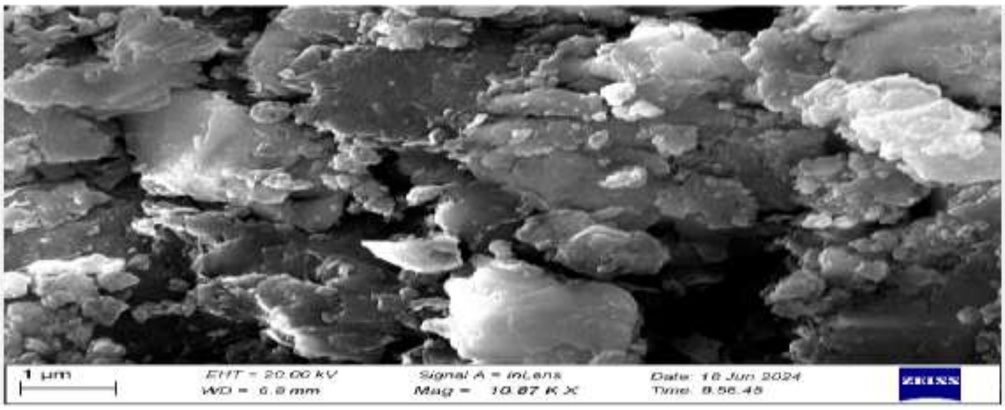
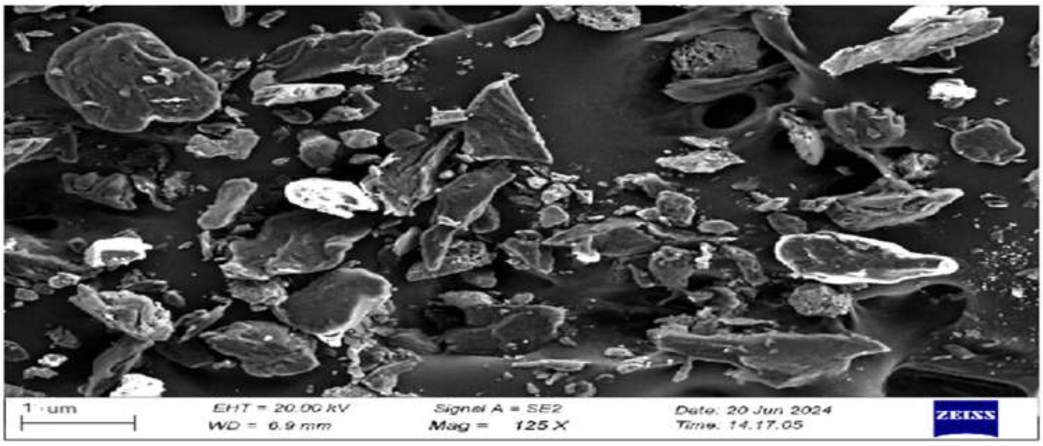


Figure 3: SEM image of (a) Agar powder

(b) SEM image of Gravelly soil



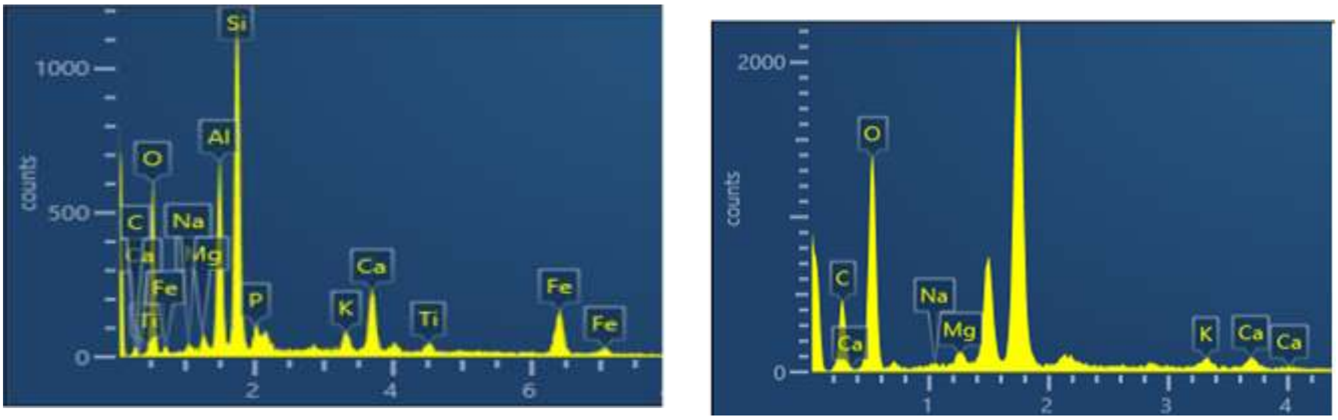
(c) SEM Image of Gravelly soil Added agar powder



Adding agar in various ratios slightly increased the pH of the soil from 7.02 to 7.19. According to electrical conductivity data, the SBD decreased from 1.70 to 1.60 mg/m, and the trend is irregular. The porosity of the gravelly soil was positively impacted by the application of agar. In varying ratios of 5–25% of agar application, the porosity ranged from 42% to 48% and the WHC rose by 33–36%. Under agar-treated soil, there are notable differences in CEC and base exchange capacity (BEC). Higher BEC (13.2–Ca, 10.3–Mg, 2.57–Na, 0.24–K) and CEC (26.03 cmol+/kg) are noted under agar control.
The agar-added gravelly soil's CEC is significant (P 0.05) and positively correlated with the studied soil sample's SOC (R gravel = 0.702) and BEC, per the Pearson correlation coefficient (Table 2). The fact that agar contains more Ca, Mg, and Na than other cations is further supported by EDS data. Agar exhibits a favorable reaction and raises the soil CEC when added to gravel soil, which has a low base exchange

Table 2. correlation of cation exchange capacity (CEC)and base exchange capacity (BEC)

Soil parameters		CEC	BEC			
			Ca	Ma	Na	K
CEC	Person correlation	1	0.725	1.000	0.390	0.997
	Sigma(two-Tailed)		0.166	0.000	0.516	0.001
	N	5	5	5	5	5



EDAX Analysis:
(a) (b)

Figure 4: Edax image of (a) Gravelly soil sample. (b) Gravelly soil added Agar powder

EDX evidently reveals that uses of Agar powder in Gravelly soil impacts oxygen dynamics in the studied soil (Figure 4). The oxygen having 33.95% in soil, but agar powder -mixed soil shows 35.89 % oxygen, which is primarily due to the porosity changes of agar powder and accumulation of more oxygen (Table 3). Iron content also shows positive changes and addition of agar increases the iron content by 1.5% in the soil. Calcium, potassium, sodium and magnesium are important basic cations influencing Cation exchange capacity [16] of the soil.

Agar powder application significantly increases the calcium, potassium, sodium and magnesium contents to the tune of 0.4%, 0.15%, 0.67 and 0.36% in the soil. This is mainly responsible for higher CEC of agar powder applied soil. In contrast to the other elements, nitrogen content increase from 2% to 8.40% which is 10.60% higher than Gravelly soil.

Agar powder has nitrogen content, which acts as food material and favours microbial growth in Gravelly soil. The increased microbes required more nitrogen for sustaining growth, for that they utilized nitrogen from the soil to meet their demands, and deplete the soil nitrogen from the original level. Application of Agar powder mixed soil augmented the Soil orgonic corban [21] and positively influenced soil morphological and physico-chemical properties.

TABLE :3 Elemental composition of Gravelly soil and Agar powder added Gravelly soil

Elements	Gravelly soil (%)	Agar Powder added Gravelly soil (%)
Oxygen	37.91	61.32
Silicon	18.91	33.45
Aluminium	4.25	9.91
Iron	2.14	10.57
Sodium	0.29	5.70
Calcium	0.30	0.40
Nitrogen	5.65	7.46
Potassium	0.90	1.77
Magnesium	0.98	1.45

CONCLUSION:

The Present Study Agar powder application increases the SOC and had a good impact on the physico-chemical of the Gravelly soil. Agar powder continues to the following factor improve the CEC of Gravelly soil, pH, EC and particle density. This study demonstrates how added SOC under specific management schemes can impact the physical, physico-chemical, and chemical properties of soil. This is because adding Agar powder to Gravelly soil enhances the supply of nutrients like Ca, Mg, Na, and K as well as the soil's ability to hold water. After testing the procedure in a lab setting, it was determined to be economical. To optimize the Agar powder dose for various crops in a changing environment, it must be evaluated in field settings with various soil types.

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