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Short Communication

INVESTIGATION OF PHYSICO-CHEMICAL PROPERTIES OF RHIZOSPHERE SEDIMENTS FROM EAST COAST REGION, TAMIL NADU, INDIA

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ABSTRACT

Objective: The objective of the present study was aimed the physicochemical properties of rhizosphere sediments from the East coast region of Tamil Nadu, India, have been investigated for soil pH, ion contents, organic contents, N and P, as well as obtaining the defined data from samples collected at different depths.

Methods: A total of 25 sediment samples from five different locations was collected at a depth of 5–20 cm from the earth's surface and analyzed for the physicochemical parameters by standard methods.

Results: The physical parameters of sediment show pH 8.02–8.36, salinity shows high in the aqueous solution of clayey sediment, ranging from a minimum of 3.2 and maximum of 5.4 dsm^{-1}. Lime content and texture shows silt to clay loam, respectively. The chemical parameters include macronutrients such as nitrogen (N), phosphorus (P), potassium (K) and micronutrients such as zinc (Zn), copper (Cu), iron (I), and manganese (Mn) were analyzed. The N, P, and K ranged from 87.5–110.5 (kg/ac), 2.9–4.5 (kg/ac), 132–169 (ppm) and the micronutrients ranged from 1.2–1.36, 0.70–1.06, 5.63–9.64, and 3.06–3.63 mg/kg, respectively.

Conclusion: The nutrient contents of the coastal sediment may vary depending on the fluctuation of the nutrient cycle from high to low. The physical properties of the soil were strongly correlated with soil fertility. Favorable physical properties occurs in highly weathered and nutrient depleted soils and limiting physical properties occurs in the least weathered and more fertile soils. Hence, they require frequent analysis of physicochemical parameters to enhance the growth of plants in a successful manner.

Keywords: East coastal sediments, Physico-chemical parameters, Macro and micronutrients.

Nutrients are substances used in biosynthesis and energy production and, therefore, known to be essential for the survival of living things. They are recycled in a characteristic pathway from the environment to organisms and vice versa. Soil resources are known to be crucially important for the survival of various types of living things due to the presence of nutrients. The dynamic soil makes a foundation for blooming a cropland, which is made up of many components such as weathered rock particles, plant and animal decayed matter with varying ratios of minerals, air, water, and organic material [1]. These components are known as major and minor elements. The availability of these nutrients is based on their distribution in soil and other physicochemical properties of the soil [2]. Nutrient pools gradually increased in concentration from the youngest to the intermediate-aged soils after which a gradual decrease was observed with the lowest values found in the most weathered soils. Soil moisture influences plant growth not only by affecting the nutrient availability, but also nutrient transformation and soil biological behavior. The forests in the protected muddy hydro environment make possible the deposition of fine sediments normally enriched with nutrients and minerals. Hence, plants in marine sediments play an essential role in the biogeochemical cycle by behaving as both supply and drop for nutrients and other minerals. The relationship between the plants and sediments are complex and dynamic as they deal with a harsh saline intertidal environment [3], degradation by human activities [4], and by natural disturbances [5]. Due to the repeated cultivation, the physicochemical properties of the soil get affected, which may lead to the modification of the nutrient content and their availability to plants. Hence, the analysis of these properties along with the nutrient status may have significant importance in the cultivation of crop plants and fertile content of the particular soil. Therefore, the present study has made to understand the nutrient status of rhizosphere soils of the East coast region of Tamil Nadu (Bay of Bengal), so that the local farmer communities can be aware of the causes of low soil productivity in their area. A total of 25 sediment samples were collected at five different locations (Muttukadu, Naipenikuppam, Pichavaram, Annakoil and Samiyarpettai) of rhizosphere zone of plants from a 5 km stretch within each station. About 1 kg of the randomized sample was taken from a depth of 5-20 cm. The collected samples were transferred into a sterile polyethene bag, sealed, and labeled immediately. All the samples were brought to the laboratory and spread over clean aluminum trays separately and air dried in shade condition. Then the samples were crushed and passed through a 2 mm sieve to remove stones, shells, and other debris. They were then packed in a sterile polyethylene bags for further investigations. The physicochemical parameters such as pH, salinity, lime content, and texture were tested. The pH was measured by using the pH pen (pHep, Henna, Portugal). Salinity was estimated by taking about 10 g of air-dried soil sample dissolved in 100 ml of deionized water. The soil solution was kept overnight after rigorous shaking for 1 h, homogenized for 30 min, and the salinity was measured at 25 °C using 'Orion-5 star' (Thermo-Orion, Scientific Equipment, USA). Lime content was determined by acid neutralization method [6].

Soil texture was determined by the hydrometer method [7]. Nitrogen was estimated by alkaline permanganate method [8] and available phosphorus was estimated by Bray method [9]. The Potassium content of the soil sample was estimated by using Flame Photometer (aipl-572, Avishkar, Mumbai) [10]. The available micronutrients (Zn, Cu, I, and Mn) were determined by the standard method proposed by Havlin and Sultanpour [11].

The chance of the nutrient variation in the soil may occur due to the long term growth of the coastal plants. In the present study, the physicochemical parameters showed that the coastal sediments were dominated by blackish brown to brown in color and alkaline in nature. Similarly, the texture analysis of two sedimentary soil cores from Pichavaram mangrove wetland and the Cauvery River delta

shows the overall predominance of fine clay with intermittent phases of sand [12]. The maximum pH (8.36) was recorded in Naipenikuppam sediments, whereas minimum soil pH (8.02) was recorded in Muttukadu, and the average pH range of coastal sediments was found to be 8.17. The maximum salinity (5.4 %) was recorded in Pitchavaram, whereas minimum salinity (3.2%) was recorded in Naipenikuppam, and the average salinity was found to be 4.1% (table 1). The other study conducted in Pichavaram mangrove showed that the high salinity in the aqueous soil solution of clayey sediment (average 4.0% and maximum 10.2%) facilitates the accumulation of salts in the root zone or at the soil surface when the capillary water evaporates [12]. Less soil salinity contents were reported in a monsoon with respect to pre and post-monsoon may be due to the maximum dilution by river run-off during the monsoon period [13]. The lime content was present in all the five stations (table 1).

Table 1: Physiological properties of coastal sediment samples

Soil property	Muttukadu	Naipenikuppam	Pitchavaram	Annakoil	Samiyarpettai
Color	Blackish brown	Blackish brown	Blackish brown	Blackish brown	Blackish brown
Textural class	Clay loam	Clay loam	Clay loam	Sandy clay loam	Sandy clay loam
Lime content	Present	Present	Present	Present	Present
pH	8.02	8.36	8.12	8.23	8.11
Salinity (%)	4.1	3.2	5.4	3.8	4.0

The texture was recorded as clay loam to sandy clay loam. The ratio of clay, silt, and sand content was maximum in Pichavaram (85:10:5) and minimum in Samiyarpettai (52:33:15) (fig. 1).

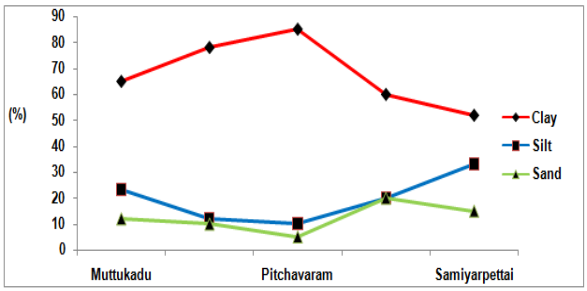

Fig. 1: Variations of soil texture in the sediments of coastal region

The nitrogen content was maximum in Muttukadu (110.5 kg/ac) and minimum in Naipenikuppam (87.5 kg/ac). The phosphorus content was maximum in Muttukadu (4.50 kg/ac) and minimum in Pichavaram (2.90 kg/ac). The potassium content was maximum in Samiyarpettai (169 ppm) and minimum in Muttukadu (132 ppm) (table 2). The maximum contents of micronutrient Zn (1.36 ppm), Cu (1.13 ppm), I (9.64 ppm), and Mn (3.63 mg/kg) were recorded in the sediments of Pichavaram, Annakoil, Muttukadu, and Pitchavaram, respectively. The minimum contents of Zn (1.2 ppm), Cu (0.70 ppm), I (5.63 ppm), and Mn (3.06 ppm) were recorded in the sediments of Muttukadu, Muttukadu, Pichavaram, and Muttukadu, respectively (table 2). The available major nutrients in the soil sample such as N, P, and K ranged from 480–986, 1.4–4.4, and 240–496 mg kg^{-1} respectively, and the concentrations of micronutrients indicated deficiencies such as Cu (1.2–16 µg g^{-1}), Zn (1.2–1.8 µg g^{-1}), Mn (3.2–3.8/µg g^{-1}), and Fe (60–108µg g^{-1}) [14]. The deficiencies of trace elements directly affect the growth and development of plants.

Table 2: Availability of macronutrients in the sediments of east coastal region

Parameters	Muttukadu	Naipenikuppam	Pitchavaram	Annakoil	Samiyarpettai
Macronutrients					
Nitrogen (kg/ac)	110.5	87.5	105.5	102.4	107.5
Phosphorus (kg/ac)	4.50	2.90	3.8	4.20	4.10
Potassium (ppm)	132.0	150	161	165	169
Micronutrients					
Zinc (ppm)	1.2	1.3	1.36	1.32	1.35
Copper (ppm)	0.70	0.90	1.10	1.13	1.00
Iron (ppm)	9.64	7.54	5.63	8.63	8.30
Manganese (mg/kg)	3.06	3.12	3.63	3.40	3.50

CONCLUSION

The coast is generally low and punctuated with deltas of several large rivers, including the Cauvery, the Palar, and the Pennar, which rise in the highlands of the Western Ghats and flow across the Deccan Plateau and drain into the Bay of Bengal. The alluvial plains created by these rivers are fertile and favor agriculture. The physicochemical parameters of the coastal sediments were deposited for many decades, and these rivers carry a large amount of soils by soil erosion during flood seasons with their nutrients and enter the head of the Bay through backwater. Hence, the net ratio of sedimentation was highest in the coastal region. The sand content of Annakoil and Samiyarpettai were slightly higher when compared with other which may be the unstable depositional environment. The higher salinity content was observed in mangrove sediments which indicated the deposition of more salt, which is likely to affect the mangrove habitat. The macronutrient content was higher in estuary sediment which reveals that nutrient transportation from the terrestrial environment by water flush. The availability of nutrients for plants was influenced by many soils and environmental factors. Thus, low nutrient availability, high metal contamination and salinity in the coastal sediment are the major threats to plant diversity.

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CONFLICT OF INTERESTS

We declare that we have no conflict of interest

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