Academic Journal of Science and Technology
ISSN: 2771-3032 | Vol. 4, No. 3, 2022

Discussion on the Necessity of Soil Organic Carbon Mineralization in Degraded Forest Land in Aeolian Sand Beach Area

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Abstract: Soil organic carbon is the largest carbon pool in terrestrial ecosystem, and its dynamic change is an important factor affecting the carbon budget balance of terrestrial ecosystem and the global carbon cycle. The forest land is extremely sensitive to the change of soil carbon pool. The wind-sand beach area in the north of Jingbian is located at the southern tip of the Mu Us Desert, and the ecological environment is fragile. The shelterbelt has been seriously degraded and fragmented, forming a large area of fragmentated forest, which has gradually changed from the original carbon sink into a carbon source. In addition, this region is dry, less rain and more wind-blown sand, which determines that temperature and moisture are the key factors affecting the mineralization and stability of soil organic carbon in this region. This paper analyzed and summarized the influencing factors of soil organic carbon mineralization, such as water, temperature and organic carbon components, and discussed the necessity of studying soil organic carbon mineralization in degraded forest land.

Keywords: Organic carbon mineralization, Temperature; Moisture, Organic carbon component, Degraded forest land.

1. Influencing Factors of Soil Organic Carbon Mineralization

Global climate change is the focus of all circles of society today, and is also the research hotspot of modern ecology. Soil organic carbon (SOC) is the largest carbon (C) pool in terrestrial ecosystem, and its dynamic change is an important factor affecting the C budget balance of terrestrial ecosystem and the global C cycle process. SOC library dynamic includes release and accumulation two processes. The release of SOC reservoir is mainly achieved through SOC mineralization, which is directly related to the formation and emission of greenhouse gases and the maintenance of soil quality [1-2]. Therefore, the study of SOC mineralization characteristics not only helps to reveal the regulation mechanism of SOC release and its stability, but also provides basic data for the in-depth study of the influence mechanism of soil C fixation capacity and the estimation of soil C reserves, and has important practical significance for the effective control of global climate change.

Soil organic carbon mineralization is an important part of the global carbon cycle and the largest component of the carbon flux from terrestrial ecosystems to the atmosphere [3]. It not only provides mineral nutrients for plant growth, but also provides energy for microbial degradation of organic matter [4]. The process of soil organic carbon mineralization is affected by environmental factors such as water, temperature, exogenous organic matter, soil texture, land use, soil pH, soil microbial quantity and activity [5-8]. Its sensitivity to water and temperature is an important index reflecting the impact of global climate change on terrestrial ecosystems [9]. Generally speaking, temperature and water have significant effects on the mineralization rate and cumulative mineralization amount of soil organic carbon, but the relative importance of the two is controversial [10]. Most studies show that in humid environment, temperature plays a dominant role, that is, the amount of organic carbon mineralization increases significantly with the increase of temperature, while in relatively arid environment, water becomes a limiting factor for organic carbon mineralization [11]. Due to the close and complex relationship between water, microbial activity, oxygen supply capacity and other factors [12-13], there is still no conclusion on the relationship between carbon mineralization and soil water and temperature.

In addition, SOC mineralization is also related to its own components. Different SOC components come from different sources, have different biostability and degradability, and have different accumulation or turnover rates in soil, which have different effects on soil C fixation and atmospheric CO_2 retention [14]. Soil active organic carbon is easily decomposed and mineralized organic carbon with a large number of components. However, most scholars [15-16] believe that microbial biomass carbon (MBC) and water-soluble organic carbon (DOC) in soil are the main characterization indicators of soil active organic carbon. Soil active organic carbon is largely affected by plants and microorganisms. Although its content is relatively small, it can reflect the subtle changes of soil in advance, so it can be used as an indicator to predict the trend of soil change.

2. Necessity of Soil Organic Carbon Mineralization in Degraded Land

As an important covering part of terrestrial ecosystem, vegetation plays an extremely important role in soil and water conservation, land conservation and carbon sequestration of

ecosystem [17]. However, as the global population increases substantially, the problem of forest degradation is increasingly serious due to human activities (such as wood cutting, fuel harvesting, burning and grazing, etc.) [18]. Forest degradation will not only lead to a series of problems such as community type change, biodiversity reduction and soil degradation, but also reduce the CO_2 sequestration capacity of forests, directly affecting the carbon cycle and carbon balance of terrestrial ecosystems. In the Wugong Mountain meadow, with the aggravation of meadow degradation, the contents of soil total organic carbon and active organic carbon components showed a downward trend [19]. However, the detailed research on the mineralization of organic carbon in degraded soil is still lacking, so it is necessary to carry out research on the characteristics of soil organic carbon mineralization in degraded forest land.

The wind-sand beach area in the north of Jingbian, located at the southern tip of the Mu Us Desert, is characterized by dry climate, less precipitation, severe wind-sand, and frequent extreme weather. Since the reform and opening up, the government has formulated the policy of "controlling sand in the north, water in the middle and soil in the south" for ecological construction. It has carried out a series of ecological construction projects, such as the "three North" shelterbelt, river basin management and desertification eradication, and formed a windbreak and sand-fixing forest system in the north. But with the change of time, successive years of drought, single tree species, too high density, unreasonable cutting and tending can not keep up with and human interference damage, make part of the shelterbelt forest phase destruction, structural imbalance, low canopy density and vegetation coverage, low economic value and ecological function, soil erosion is serious, causing a negative impact on the local ecological environment, people call this kind of woodland as damaged forest. The degradation of shelterbelt into residual forest will cause changes in community structure, soil nutrients, water and other physical and chemical properties, and the change of soil organic carbon, which will affect the mineralization of soil organic carbon and the transformation of organic carbon components. In recent years, researches on SOC mineralization mainly focus on the black soil, forest frozen soil, paddy soil and loess in the loess hilly region of Northeast China, but there are few researches on the Aeolian sand soil in the degraded degraded forest in the Aeolian sand beach area of northern Shaanxi where extreme weather occurs frequently.

3. Study Area of Degraded Forest Land in Aeolian Sand Beach Area

The wind-sand beach area in northern Jingbian County of Shaanxi province lies between 36°58 '45 "-38°03' 15" north latitude and 108°17 '15 "-109°20' 15" east longitude. It is located in the southern margin of Mu Us Desert, with high terrain in the south and low in the north and west. This area belongs to the temperate semi-arid continental monsoon climate, the temperature difference between day and night is large, frost-free period is short, less rain, more wind sand. The average annual temperature is 7.8℃, the average temperature of the hottest month (July) is 22.2℃, and the average temperature of the coldest month (January) is 8.5℃. The annual precipitation is 395.4 mm, and the precipitation mainly concentrates in July, August and September, accounting for 62% of the annual precipitation. The annual average evaporation is 1930mm, and the distribution of precipitation and evaporation is uneven within the year. The soil type is mainly Aeolian sand soil. The total area of the study area is 27.9910 hm^2, including tree forest land 2.0101hm^2, shrub land 10.7027hm^2 and other land 3.1587hm^2.

4. Conclusion

To sum up, it is necessary to study the characteristics of soil organic carbon mineralization in degraded forest land in the north of Jingbian by combining the first-order soil organic carbon dynamics model and temperature sensitivity equation for the uncertainties of the effects of temperature, moisture and forest degradation on soil organic carbon mineralization and stability, which has important theories for the implementation of carbon sequestration measures in degraded forest land, vegetation reconstruction and cultivated land restoratione

Acknowledgment

This work was jointly supported by the Scientific Research Item of Shaanxi Provincial Land Engineering Construction Group (2020-NBYY-39) and Shaanxi Provincial Land Engineering Construction Group fund（DJNY-2022-21）.

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