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Effects on Soil Organic Carbon under Reduced Fertilizer Application

Nan Lu[1, 2, 3, 4, a, *], Yan Li[1, 2, 3, 4, b]

[1]Shaanxi Land Engineering Construction Group Co., Ltd., Xi'an, China

[2]Key Laboratory of Degraded and Unused Land Consolidation Engineering, the Ministry of Natural Resources, Xi'an, China

[3]Shaanxi Land Consolidation Engineering Technology Research Center, Xi'an, China

[4]Institute of Land Engineering and Technology, Shaanxi Land Engineering Construction Group Co., Ltd., Xi'an, China

[a]lunan8836@126.com, [b]liyan_hhu@163.com

Abstract

Different management practices affected the rate of soil carbon sequestration, which may be related to differences in soil nutrient effectiveness due to different nutrient inputs. Organic fertilizer application improved the stability of soil organic carbon through the formation of organic calcium complexes, and soil organic carbon and microbial carbon were the key variables regulating the structure of microbial communities. Soil active organic carbon content and carbon fraction sensitivity index can effectively reflect the activity of soil carbon pools, the long-term effect on soil organic carbon sequestration and quality improvement, continuous chemical fertilizer reduction, with the optimization of organic fertilizer fertilizer fertilizer management measures to explore is the hot spot of current research.

Keywords

Soil organic carbon, carbon sequestration, soil carbon sequestration efficiency.

1. INTRODUCTION

Soil organic carbon is a key component of soil fertility and quality, and its content and quality directly affect the level of soil fertility and quality [1]. The soil carbon pool is twice as large as the atmospheric carbon pool, and subtle changes in the soil carbon pool not only affect the quality of soil fertility, but also greatly affect the changes in the atmospheric carbon pool, and soil carbon fixation occupies an important position in the global carbon balance [1-2]. Soil carbon pools, of which organic carbon pools account for a relatively large proportion, are susceptible to farming practices and less stable [3], and agricultural production affects soil organic carbon by directly altering organic carbon inputs and by indirectly altering the environmental conditions of microorganisms [4]. Therefore, soil carbon sequestration not only affects climate change, but is itself a process of improving soil quality and promoting green and sustainable agriculture [5].

2. INCREASED SOIL CARBON SEQUESTRATION CAPACITY

Reasonable agricultural practices can improve soil carbon sequestration capacity through two strategies: increasing carbon inputs and reducing soil organic carbon loss, which in turn increases the rate of soil carbon sequestration and the amount of carbon sequestration [4-5].

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Existing studies have shown that long-term application of farmyard manure maintains soil fertility by accumulating and sequestering carbon in the soil under intensively cultivated rice-wheat cropping system [6]. Long-term organic-inorganic rationing significantly alleviates soil acidification caused by chemical fertilizer application and improves soil organic carbon pools [7].

Soil carbon pool activity index is an important index to characterize the availability of soil organic carbon, reflecting the changes in the amount of active organic carbon in the soil, which can effectively measure the availability of soil organic carbon under land management measures, the higher the activity index, the stronger the availability of soil organic carbon [8]. Soil carbon pool management index is a comprehensive index that characterizes the influence of external conditions on soil organic carbon content and the activity of soil carbon pool, which can reflect the influence of external conditions on soil organic carbon in a more comprehensive and dynamic way [9].

3. SOIL CARBON SEQUESTRATION RATE AND SEQUESTRATION EFFICIENCY

Different nutrient inputs lead to differences in soil nutrient effectiveness [10] . Elevated nitrogen effectiveness inhibits enzymes associated with the degradation of recalcitrant carbon fixation components, thus promoting soil carbon fixation; elevated nitrogen effectiveness can also change the chemical properties of soil organic carbon and increase its stability [11]. In addition, cumulative carbon inputs and critical carbon inputs have important effects on maintaining soil carbon sequestration [12].

Organic fertilizer application increases the stability of soil organic carbon through the formation of organo-calcium complexes, and soil organic carbon and microbial mass carbon are key variables that regulate microbial community structure [13]. The soil organic carbon sequestration efficiency was first increased and then reached equilibrium by successive different proportions of chemical fertilizer reduction with organic fertilizer, indicating that excessive carbon inputs are not conducive to soil carbon sequestration. On the one hand, it may be related to the effect of organic fertilizer dosing on soil environmental factors [14]; on the other hand, it may be related to the stability of soil organic carbon [15]. In recent years, conceptual models simulating soil organic matter formation have emphasized the major role of organic matter inputs from microbial sources and suggested that the physiological characteristics of microorganisms are the main factors regulating soil organic matter; however, recent studies have also pointed out that the direct contribution of plants to soil organic matter is much greater [16]. Wang et al [17] showed that organic carbon sequestration mainly depends on organic fertilizer amendments. Cai Shandong et al [18] showed that long-term application of organic fertilizers significantly promoted root stubble carbon input and increased the level of total organic carbon storage. Wang et al [19] showed that phosphorus application in agroecosystems could alleviate microbial phosphorus and nitrogen limitation, and reduce carbon loss by increasing microbial carbon use efficiency. Wu et al [20] analyses showed that organic inorganic fertilizer-mediated microbial carbon use efficiency increase has an important effect on soil organic carbon sequestration.

4. SOIL CARBON POOL ACTIVITY AND POOL MANAGEMENT INDICES

Soil active organic carbon (LOC) content and carbon sensitivity index can effectively reflect the activity of soil carbon pools [21]. The sensitivity indices of carbon components were significantly higher in different fertilizer reduction rates with organic fertilizers, and the sensitivity indices of soil active organic carbon (LOC) were significantly higher than those of other carbon components in different fertilizer reduction rates with organic fertilizers. Soil active organic carbon can be used as an indicator of carbon pool management index under

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different rates of fertilizer reduction and organic fertilizer application. It may be related to the input of exogenous organic matter in the first place. Organic fertilizer dosing increased the proportion of active organic carbon in the soil carbon pool, thus increasing soil carbon pool activity [21]. Secondly, it may be related to soil enzyme activity and soil microbial activity. Organic fertilizer distribution increased the effect of soil enzymes and microorganisms on soil organic carbon fractions [22]. It may also be related to the different nutrient inputs. Li et al [23] showed that microbial changes induced by nitrogen and phosphorus additions accelerated the decomposition of inactive organic carbon fractions, resulting in a decrease in the soil inert and organic pools, but an increase in the active carbon pool. This can also explain why the soil active organic carbon sensitivity index was significantly higher than the other carbon fractions in this study under successive fertilizer reductions with different rates of organic fertilizers, and the active organic carbon was the most responsive to the carbon pool management index.

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