

Effects of Agricultural Waste Application on Soil Carbon Emission in Newly Cultivated Land

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Abstract: Cultivated land is an important resource to ensure food production and food security. However, the low degree of soil ripening, poor soil and lack of organic matter are common problems in newly cultivated land. Fertilization can effectively improve the physical properties of soil, improve soil nutrients and fertility, but long-term application of inorganic fertilizer will cause soil compaction or even degradation. Returning agricultural waste to the field can not only increase soil fertility and effectively improve soil structure, but also change soil carbon emissions. In this paper, the benefits of straw returning and livestock manure composting and their potential effects on soil carbon emissions were summarized to provide ideas for improving the fertility of new cultivated land.

Keywords: New arable land, Straw returning, Animal organic fertilizer, Soil carbon emissions.

1. Introduction

Cultivated land is an important resource to ensure food production and food security, and to ensure that the quantity and quality of cultivated land do not decrease is a clear requirement put forward by the Central Rural Work Conference. At present, reserve land resource has been exhausted, which seriously restricts the development of social economy and threatens the national food security. It is an urgent problem to seek for new cultivated land reserve resources in land development and utilization. Ecological land consolidation project has become an effective means to solve the problem of degraded land, damaged land and so on. However, the low degree of soil ripening, poor soil and lack of organic matter are common problems. Fertilization, tillage, land use and other factors affect the content and structure of soil organic carbon, but long-term application of inorganic fertilizer will cause soil compaction and even degradation. Organic materials can make use of the periodic change of soil water and heat with small daily variation to create a good living environment for microorganisms, so that they can successfully complete the humification process and form the core matter of water and fertilizer preservation -- humus, thus improving soil fertility, crop yield and quality. Therefore, it is of great significance to improve the soil fertility and crop yield of new cultivated land by applying all kinds of organic materials.

2. Straw Returning

In recent years, agricultural waste recycling has been attached importance by people, and China has a huge output of crop waste resources [1]. From 2014 to 2018, the average annual output of straw in China reached as high as 6.5387×10^8 t, among which the output of cereal, wheat and corn straw accounted for 32.3%, 22.7% and 45.0% respectively. As an important agricultural technology, straw returning to field can improve soil quality, increase SOM content and enhance fertility, so it has attracted great attention.

Straw is used as a carrier of matter, energy and nutrients. After returning to the field, part of straw is decomposed into simple inorganic substances by soil microorganisms, and the other part forms a class of large-molecular weight substances that are difficult to degrade, thus becoming the main component of soil organic carbon. Cui Zhengguo et al. [2] showed that straw returning to the field could significantly increase the content of soil active organic carbon, and with the increase of corn straw returning to the field, the content of soil active organic carbon would also increase. Straw returning to the field has a significant effect on increasing fertilizer yield, generally increasing yield by 5% ~ 10%. However, if the method is not proper, it will also lead to the increase of soil bacteria, crop diseases and lack of seedlings (dead seedlings) and other adverse phenomena. Therefore, reasonable straw returning measures can achieve good results. There are many forms of straw retting, which can be divided into 5 main types: straw compost retting, straw mulching retting, pile retting, incineration retting and overbelly retting.

3. Return Livestock and Poultry Manure to The Field

In addition, organic manure produced from livestock and poultry manure is more and more used in soil fertilizer. The effects of organic manure composting include improving the physical, chemical and biological properties of soil, keeping the soil environment in a good state suitable for crop growth, and improving the fertilizer effect of fertilizers. After the use of compost, the soil can increase the formation of granular structure, has the following effects on the soil: 1) make the soil soft, multi-gap, easy to cultivate, increase water holding capacity, permeability and permeability, improve the physical properties of the soil. 2) Ammonia and potassium in fertilizer exist as cations. Because humus is negatively charged, it helps to maintain soil nutrients and improve fertilizer protection. 3) The chelating components in the humus combine with the active aluminum in the soil and make it become inactive substances, thus inhibiting the harmful effect of the

combination of active aluminum and phosphate. Because the chelating agents in the compost can be combined with aluminum, iron and other metals, it can make the fixed state easy to decompose; Promote organic decomposition, promote nitrogen fertilizer and other nutrients supply; In addition, copper, chlorine, cadmium and other heavy metals harmful to crops can also react with humus to reduce their harm and facilitate plant growth. Most studies have shown that the application of organic fertilizer has a positive effect on the improvement of soil organic carbon and its components. The study of Yousefi et al. [3] showed that with the increase of the amount of organic fertilizer, the stability of soil aggregates, the contents of organic carbon, water-soluble organic carbon and hydrolyzed compounds of weak acid further increased. The research results of Li et al. [4] showed that the application of organic fertilizer increased organic carbon and active components. The application of animal manure can promote the activities of microorganisms and earthworms, etc., and increase the content of soil polysaccharide and humus substances [5, 6].

4. Soil Organic Carbon Mineralization

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 [7]. It not only provides mineral nutrients for plant growth, but also provides energy for microbial degradation of organic matter [8]. 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 [8-12]. Based on different sources of soil organic carbon components, exogenous organic substances have different biological stability and degradability, and their accumulation or turnover rates in soil are different, which have different effects on soil C fixation and atmospheric CO₂ retention [13].

5. Soil Carbon Emission and Return of Organic Materials to Farmland

Soil is one of the main sources of atmospheric CO₂ and plays an important role in the increase of atmospheric CO₂ concentration. The global decline of soil organic carbon has increased atmospheric CO₂ concentration by nearly 140 ppmv[14]. The annual net release of CO₂ from soil to atmosphere is 0.2 ~ 0.9GtC (1G tC =1015 g), accounting for about 5% ~ 20% of the global total [15]. The input of foreign organic matter will cause the strong change (promote or inhibit) of soil organic matter turnover. A large number of studies have found that the input of exogenous organic matter can significantly promote the decomposition of soil organic carbon [16-17] and has an important impact on the dynamics of soil organic carbon [18]. From the perspective of farmland fertility, high content of active organic carbon is conducive to mineralization and improvement of nutrient supply [19-20]. The changes of organic carbon composition and content were strongly influenced by farmland management measures, including straw returning, fertilization and tillage methods. The degradation of soil organic carbon (physical, chemical and biological degradation) is mainly reflected by mineralization and decomposition. The mineralization process is a key step of soil carbon cycle and an important indicator of soil quality change. Therefore, the application of exogenous agricultural waste in new cultivated land will also

have a potential impact on soil carbon emission.

6. Summary

In order to ensure the red line of 1.8 billion mu of cultivated land, the area of newly added cultivated land increased significantly. Previous studies on soil physical and chemical properties and crop growth characteristics of newly added cultivated land were numerous, but the research on soil organic carbon mineralization was still lacking. Therefore, through the analysis of this paper, it is necessary to study the soil carbon emission after the application of organic materials in new cultivated land.

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