

Effects of Municipal Sludge Composting on Culture Medium Indexes

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Abstract

According to the results of relevant studies, we found that municipal sludge composting can not only significantly increase the content of available nitrogen and phosphorus in different cultivation substrates, but also enhance the water retention performance and drought resistance of plants. The application of composting municipal sludge to plant cultivation can not only realize the resource utilization of municipal sludge, but also contribute to the harmless treatment of municipal sludge. Sludge compost contains nitrogen and phosphorus equivalent to organic fertilizer, but also contains potassium, calcium, iron, sulfur, magnesium and other nutrients, but also contains trace elements including zinc, copper, boron, molybdenum and so on. In addition, nitrogen and phosphorus in sludge compost are organic, so sludge compost can be used to replace fertilizer. The disadvantage is that the nutrient mix is unreasonable, and attention should be paid to supplement the missing nutrients. This review provides a theoretical basis for the scientific application of urban sludge compost, and is of great significance for promoting the sustainable development of agriculture and food safety.

Keywords

Municipal sludge; Potted medium; Water retention capacity; Sludge resource utilization.

1. INTRODUCTION

Sludge refers to the precipitated matter produced in the wastewater treatment process and the residue of the withdrawal of the floating foam from the sewage surface. The composition of sludge varies greatly due to the different sources of sewage, the treatment process of sewage treatment plants and the changes of seasons, but the sludge will become an effective fertilizer resource after special agricultural treatment. Municipal sludge contains a large amount of organic matter, rich nitrogen, phosphorus and a small amount of potassium, and there are various trace elements such as boron and molybdenum needed for crop growth. However, compared with developed countries, China's municipal sludge belongs to the type of low organic components. The average content of organic matter in municipal sludge (excluding industrial sludge) is lower than that of pure pig manure but higher than that of pig manure. The average content of N and P was higher than that of pig manure and pure pig manure. The average content of potassium is lower than that of pure pig manure and pig manure. Many scholars have done a lot of research on the effects of urban sludge farming on plant growth and environment. Zhang Tianhong (1993) With the increase of municipal sludge application amount, the contents of total nitrogen, total phosphorus and organic matter in Table (0-20 cm) increased [1]. Ma Sangui (2022) showed that the basic physical and chemical properties of the sludge in the sludge treatment plant could basically meet the requirements for the application of landscaping, the organic matter content in the sludge could even be comparable to that of traditional organic fertilizers, and the odor in the sludge could be improved or even disappeared after aerobic composting [2]. Some research results show that urban sludge can replace soil for

horticultural crop production, and it is feasible. The treated municipal sludge was added to the planting beds of horticultural crops, vegetables and lawns in different proportions. It was found that the application of sludge had significant effects on soil physicochemical properties, soil heavy metal content and plant growth response. This study obtained important data support through a large number of planting experiments. The results showed that sludge could replace fertilizer for soil fertilization and could be used as one of the substrates for soilless cultivation.

2. TYPICAL CHARACTERISTICS OF MUNICIPAL SLUDGE

2.1. Large amount of sludge and fast growth

The process of economic and cultural construction in China's big cities is gradually accelerating, and the resident population of almost all cities is increasing, and the increase of urban population means that the discharge of domestic sewage and industrial wastewater is increasing. As early as a few years ago, the large and small cities of our country have had many sewage treatment plants. These sewage treatment plants not only treat the sewage generated by people in daily life, but also treat the wastewater generated in industrial production. As early as many years ago, the acceleration of China's urbanization process means that the level of industrialization has been improved, and the production of industrial wastewater is also increasing, industrial wastewater is very different from domestic sewage, which contains more impurity elements, and the damage to the environment is greater.

The construction of sewage treatment plant is the inevitable demand for environmental protection, sewage after treatment will not cause huge environmental pollution like untreated, but the treated sewage will produce another substance that may pollute the environment-sludge during its purification process. The more sewage treated means that the amount of sludge continues to grow, so the acceleration of the urban construction process has also increased the sludge production.

2.2. Municipal Sludge contains a variety of harmful substances or pollutants

Sludge internal with a lot of organic matter, some of these organic matter can be used, but also harmful to the environment, not only that, which may contain a variety of pathogens, parasite eggs, due to the unstable characteristics of the sludge, all in the degradation process easy to produce odor, but also easy in the process to pollute the surrounding clean area of the environment and cause secondary pollution.

Under normal circumstances, a large number of harmful substances enter the sludge from the water when the sewage treatment plant treats the sewage, and these harmful substances inevitably find their next shelter in the sewage treatment process, so they are transferred to the sludge.

Sludge can be regarded as a large number of organic and inorganic matter polymers. It is worth mentioning that there are a wide variety of heavy metals in the sludge, including Cu, Pb, Zn, Ni, Cr, Hg, Cd, etc. These heavy metal elements are the main obstacle to the resource utilization of the sludge.

Some scholars from the United States Environmental Protection Agency (USPEA) and other organizations have made statistics on the pathogens present in sludge, and found that the confirmed pathogens in sludge include 24 kinds of bacteria, 7 kinds of viruses, 5 kinds of protozoa and 6 kinds of parasites [3]. In the process of sludge treatment and disposal, these pathogens may contaminate the soil through various ways and accelerate the spread of plant diseases to a certain extent.

2.3. The municipal sludge is rich in nutrients

The content of organic matter and nitrogen, phosphorus and potassium in the sludge is relatively rich, and trace elements such as calcium, zinc and iron exist, which are themselves nutritional elements, so they can promote the growth of plants. In addition, the humus produced by the decomposition of organic matter in sludge can improve the soil and is a good soil amendment. Because the sludge contains relatively rich nutrients, it can be used as a kind of agricultural fertilizer and the humus in it also has an improving effect on the soil, so its agricultural value has been paid special attention. We can make full use of the nutrients in it, for the purpose of turning waste into treasure, and then use sludge to improve the soil, strengthen the soil fertility, so that crops can get better growth.

In addition, the application of sludge can also improve the activity of some soil enzymes, so as to improve soil fertility and improve soil ecological environment. Tan Q L et al. found that the application of chemical fertilizer had a tendency to promote the increase of soil urease activity [4]. In the absence of chemical fertilizer, the application of sludge also had a tendency to promote the increase of soil urease activity, but it did not reach a significant level. In the case of fertilizer application, the activity of soil urease increased significantly with the increase of sludge application amount. In other words, with the increase of sludge application amount, the activity of urease in soil was also enhanced while the soil organic matter and nitrogen nutrition were improved.

2.4. High moisture content of sludge is difficult to carry out follow-up treatment

Most municipal sludge is difficult to complete solid-liquid separation, because of its colloidal structure, and has a certain hydrophilicity, easy to pipeline transportation, but poor dehydration performance. In addition, some of the sludge treatment process to add flocculant, even after the plate frame, belt machine and other mechanical dehydration treatment, the water content is still as high as 75%, difficult to further disposal and utilization. Because the sludge itself is the product of sewage treatment, it is technically difficult to meet the requirements of complete dehydration, and because the moisture content is too high, its next disposal also has problems.

3. MUNICIPAL SLUDGE COMPOSTING TREATMENT

3.1. Effects of municipal sludge as culture medium

Municipal sludge composting can not only significantly increase the content of available nitrogen and phosphorus in the cultivation substrate, provide nutrients required for plant growth, but also enhance the water retention performance of the cultivation substrate and the drought resistance of plants. When the water content is the same, it is more difficult for plants to absorb water from municipal sludge compost than from soil, and the wilting point of using municipal sludge compost as cultivation substrate is higher than that of using soil as cultivation substrate. Therefore, from the perspective of ensuring the water supply of plants, the amount of urban sludge compost is not the more the better, when the amount of more than 75%, continue to increase the proportion of urban sludge compost, the water absorption capacity of plants will decrease slightly. From the perspective of nutrient supply and water retention performance, the utilization of compostated municipal sludge as a plant cultivation substrate is a feasible resource technical approach [5].

3.2. Effect of municipal sludge on mixed soil

Organic matter in sludge can effectively improve soil structure, soil hydraulics, soil chemistry and biological properties. It can improve the activity of microorganisms, promote the formation of aggregates and increase the soil voids, which is conducive to ventilation and exhaust, increase

the soil water storage capacity, and thus improve the soil ploughability. Studies have found that applying sludge can also reduce fertilizer input by 30% to 40%, reduce sludge treatment costs, and prevent harmful substances from entering the food chain. After application, sludge can fertilize soil, improve nutrient status and promote nutrient balance. Soil organic matter, nitrogen, phosphorus and potassium content is a kind of permanent fertilizer like chemical fertilizer and other organic fertilizers [6].

3.3. Effect of municipal sludge on organic pollutants

There are a lot of pathogenic microorganisms and polycyclic aromatic compounds (PAHs) in the organic pollutants of sludge. The pathogenic bacteria can be overcome by physical measures, that is, removal by pile retting for a period of time, but PAHs is not easy to eliminate in the sludge. PAHs is a kind of extremely complex persistent organic pollutants with a large variety of derivatives, which can lead to soil and crop pollution if it is not treated directly for agricultural use or stacking [7].

3.4. Heavy metal accumulation

In general, the situation of excessive heavy metals in urban sludge is rare, and its main components are human manure, kitchen tableware residue, dishwashing liquid, sediment, etc., which only occurs when the pipe network is leaking or mixed. From the relevant research results at home and abroad, in a short period of time, the heavy metal content of urban sludge on crops did not exceed the national food quality and safety standards. However, in the long-term sludge treatment process, there are still some agricultural products with excessive heavy metal content [8]. Wu Xinmin (2005) found that heavy metals in urban sludge showed strong activity and mobility, and the accumulation and migration of different types of heavy metals in their bodies were different, and long-term use would cause the accumulation of heavy metals in soil and organisms, and bring certain environmental risks to them [9].

4. CONCLUSION

In summary, the research results have good market prospects and application value, but the effects of various sludge varieties are different. Sludge application can promote crop growth and development, improve seedling germination, growth and other physiological and biochemical indexes, can significantly promote the absorption of soil available nutrients, increase grain yield and biomass, and improve soil physical and chemical properties. Sludge application is not the more the better, in the appropriate range is safe, the sludge contains heavy metals, organic pollutants, etc., but the heavy metal in the urban sludge is generally uncommon, but the heavy metal content in the sludge is much higher than the original soil, different amounts, different quality and different places of sludge to improve the quality of the soil is not the same, need to master the correct method. The absorption and accumulation of heavy metals in crops and soil can reach the national food safety and sludge pollutant limit standards with some exceptions.

5. EXPECTATION

To study the effect of sludge utilization on soil physical and chemical properties, it is necessary to determine the physical and chemical properties of soil in different soil layers and different growth periods in the field, which often lacks research on the changes of soil physical and chemical properties during the whole growth period of crops. In addition, there are also many problems in sludge use. First, the heavy metal content in sludge is much higher than that in the original soil, and the amount of sludge application needs to be strictly controlled. It's safe within the bounds of propriety. Second, most of the current tests are short-term, and it is necessary to form multiple long-term quantitative monitoring tests in the future. Therefore, the

heavy metals and organic pollutants are strictly controlled, and the sludge can be used for plant production under a certain amount of controlled conditions. At the same time, practical management measures should be taken to strictly control the quality of sludge compost and prevent pollution of harmful heavy metals. With the development of urban industrialization, other resources need to be developed.

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