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Original Paper

Effects of Arbuscular Mycorrhizal Fungi on Accumulation of Heavy Metals in Rhizosphere Soil

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Abstract

The rhizosphere soil arbuscular mycorrhizal fungi will affect the absorption of heavy metal substances by the host plants. The effects of the arbuscular mycorrhizal fungi are inhibitory and conversion effects. The type and quantity of AMF fungi are different, and there are also differences in the absorption of arbuscular mycorrhizal fungi in the rhizosphere soil. Changes in the accumulation of heavy metals will affect the growth of arbuscular mycorrhizal fungi in the rhizosphere soil. In this paper, a preliminary investigation is made as to whether the AMF fungus number will affect the absorption of heavy metal Cd. Experiments show that with the increase of soil spores, the available cadmium content of soil also tends to increase.

Keywords

heavy metal accumulation, rhizosphere soil, arbuscular mycorrhizal fungi

1. Introduction

Heavy metal pollution in soil has become an important factor affecting the ecological environment. The enrichment of heavy metals in plants will cause humans to accumulate a large number of heavy metals, and then affect their health. Arbuscular Mycorrhizal Fungi (AMF) is a kind of fungus that symbiotic with plants. It has a great influence on the heavy metal uptake of plants. AMF can directly metabolize plants in environments with heavy metal accumulation. The process of adjustment to reduce the toxic effects of heavy metals on plants is an appropriate means of heavy metal pollution treatment.

2. Heavy Metals on AMF Fungi Conversion and Inhibition

In the soil, water-soluble and exchangeable heavy metals are easily absorbed by plants. AMF fungi can change the chemical forms of heavy metal elements in the plant rhizosphere soil, reduce the absorption of heavy metal elements by plants, and then reduce the heavy metals for plant growth. Impact, reduce the plant's enrichment of heavy metal elements. In addition, AMF fungi can change the physical and chemical properties of soil by changing the amount and proportion of microorganisms in the soil, affecting the morphology and properties of heavy metal elements, and reducing the absorption of heavy metal elements by plants.

AMF fungi will form a large-scale rootless mycelium network in the soil, which has a strong adsorption function, adsorption function can be fixed in the soil of heavy metal ions, to avoid the movement of heavy metals through the plant to move to the upper part of the soil the inhibition of the diffusion of heavy metal ions is called inhibitory effect. The inhibitory effect of different AMF fungi on metal ions is different. When the heavy metal accumulation concentration is too large, the growth of mycelium will cause anti-inhibition and misuse, and then reduce the impact of AMF fungi on heavy metal ions.

3. The Impact of AMF Fungi on the Adjustment of Heavy Metals Important Factors

3.1 AMF Fungus Species and Quantity

The number and species of AMF fungi are one of the important factors affecting the regulation of heavy metal uptake by AMF fungi. In the process of plant growth, there is a certain relationship between the absorption of heavy metals and the type and amount of AMF fungi in the soil. Among the soils with different heavy metal accumulations, the species and number of AMF fungi will change. Under the condition of heavy pollution of heavy metals, the number of species of AMF fungi is the most, and most AMF fungi are distributed. Under the conditions of moderate or mild heavy metal pollution, the number of fungal cynomolgus and Glomella species is the highest; no soil cultivars in the heavily polluted soil appear in the soil. However, there is a small amount of Glomus spp. which has a strong adaptability and has its distribution in a variety of soils. Among the moderately and lightly contaminated soils, Glomus spp. has the strongest cleaning effect and can be stored in a variety of environments. However, in heavily polluted areas of heavy metals, the accumulation of heavy metals will have an anti-inhibitory effect on the presence of mold, affecting its effect on soil remediation, and the effect of mold on plant absorption is not obvious.

3.2 The Other Factors

In the process of actual heavy metal absorption and purification, the differences in plant species, planting density, and growth environment also affect the effect of bacterial communities on the absorption and regulation of heavy metals. Among the rhizosphere soils, AMF fungi have a wide range of plant species, and AMF strains can be found in the rhizosphere soils of various plants. In the current study, it has been found that plants that form a symbiotic relationship with AMF include Tobacco, corn,

sorghum and so on. Different types of plants, there are some differences in their metabolic processes and secretions, thus affecting the distribution of AMF bacteria, affecting the accumulation of heavy metal elements. The planting density of crops and the growth environment of plants also affect the growth and reproduction of AMF strains. Unreasonable planting density will inhibit the growth of AMF strains, which in turn will reduce the absorption of heavy metals in the soil. The growth environment of the plant will also affect the nature of the strains. The AMF strains in the drought environment have a certain degree of drought tolerance. The AMF strains in the salty environment often have a certain salt tolerance, and these factors will directly affect the absorption of heavy metals.

4. Relationship between AMF Fungi Quantity and Heavy Metal Cadmium Pollution

The type and quantity of AMF fungi mentioned in the second major point above are important factors for the regulation of heavy metal absorption. Taking the rhizosphere soil of the eucalyptus trees in Nanchang City as the research object, the following experiments were performed.

4.1 Research Method

4.1.1 Sample Summarization and Sampling

Nanchang is a subtropical humid monsoon climate with a mild and humid climate and abundant sunshine. Within one year, it is short in spring and autumn, summer is long, and Xiayan is cold. Lushan South Road is located at the intersection of Panzhi Lake Avenue and Lushan South Road in Nanchang. The sampling road is on the side of the national road. The rhizosphere soil of the four eucalyptus trees was selected as the sampling object. The soil samples collected from 0-20 cm and 20-40 cm near the roots of the banyan trees were collected and brought back to the laboratory for analysis.

4.1.2 Soil Sample Processing and Measurement Methods

The soil was brought back to the laboratory for natural air-drying and sifted through a 2 mm screen; the available heavy metal cadmium was extracted on 0.1 mol/L hydrochloric acid and measured on an ICP instrument; the AMF fungal spores were first vortexed by sucrose centrifugation and then Spore counts were performed under a 20X dissection microscope.

4.2 Analysis of Results

According to Table 1, the effective cadmium content in the 0-20 cm soil in the determination area is 0.11 to 0.14mg/kg, the average effective cadmium content is 0.12mg/kg, and the available cadmium content in the 20-40cm soil is 0.08 to 0.11mg/kg, the average effective cadmium content is 0.09mg/kg. The number of spores per 100g of soil in the 0-20cm soil area is 134 to 571, and the average number of spores per 100g of soil is 387; the measurement area is 20-40cm. The number of spores per hundred soil in the soil is 201-441, and the average number of soil spores per hundred grams is 321. From the data, it can be seen that with the increase of soil spores, the available cadmium content in soil is also increasing. This indicates that the experiment failed to show that the spore count of AM fungi is not a major factor affecting soil cadmium contamination. There are many factors that cause the opposite result of the experiment, such as the non-standard sampling, the soil may not be the original soil, there

is a large error in the effective cadmium content of the soil, and the spore quantity may be calculated manually. Big error. The soil samples taken in the experiment were also few and could not be representative.

Table 1. Cadmium Content in Soil and Amount of Spores Per Gram Soil in the Study Area

Area	Numbering	Available cadmium in soil (mg/kg)		Per 100 grams of soil spores	
		(0-20) cm depth soil	(20-40) cm depth soil	(0-20) cm depth soil	(20-40) cm depth soil
Research Area	Sample 1	0.11	0.10	475	406
	Sample 2	0.11	0.09	134	235
	Sample 3	0.13	0.11	571	441
	Sample 4	0.14	0.08	369	201
	Mean	0.12	0.09	387	321

5. Conclusion

AMF fungi is an important means to achieve the purification of heavy metals in soil and reduce the absorption of heavy metals by plants. In the actual growth process, other factors such as the type and amount of AMF fungi affect the absorption of heavy metals.

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