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重金属污染对水稻田土壤硫酸盐还原菌种群数量及其活性的影响

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Effect of heavy metal contamination on the population of sulfate-reducing bacteria and the sulfate-reducing activity in paddy rice soils

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摘要 在实验室条件下,采用重金属Cd^{2+}、As^{5+}、Cu^{2+}、Pb^{2+}和Cr^{3+}处理黄松稻田土壤、紫色稻田土壤和红壤稻田土,28d后分析重金属污染对水稻田土壤的硫酸盐还原菌(SRB)种群数量和硫酸盐还原活性(SRA)的影响。结果表明,在每千克干土中加入200mgPb^{2+}时,对稻田土壤的SRB种群数量和SRA有促进作用;当加入的Cd^{2+}、As^{5+}、Cu^{2+}、Pb^{2+}和Cr^{3+}每千克干土分别超过1.0、30、500、400和200mg时,对稻田土壤SRB种群数量和SRA有明显抑制作用。随着加入量的增加,重金属对水稻田土壤的SRB种群数量和SRA的抑制作用越来越强,水稻田土壤通过自身来恢复SRB种群数量和SRA所需的时间也越长。同一种重金属元素对不同土壤的SRB种群数量和SRA抑制的污染临界值也有差异。

关键词: 硫酸盐还原菌 硫酸盐还原活性 重金属污染 稻田土壤 硫酸盐还原菌 硫酸盐还原活性 重金属污染 稻田土壤

Abstract: The responses of microbial to soil heavy metal-contamination were studied by comparing the changes in the population of sulfate-reducing bacteria (SRB) and the sulfate-reducing activity (SRA) in three types of paddy soils under laboratory condition. The experimental soils were Huangsong paddy soil, Red paddy soil and Purple paddy soil. Huangsong paddy soil developed from shallow-sea deposit of intermediate lake deposit, Red paddy soil developed from alluvial deposit, and Purple paddy soil developed from parent material of neuter purple sandstone and shale. Soils were treated with different concentration of Cd^{2+}, As^{5+}, Cu^{2+}, Pb^{2+} and Cr^{3+}. The results showed that the population of SRB and the SRA were slightly increased by adding Pb^{2+}(200 (mg/kg) dried soil), while the population of SRB and SRA were prominently inhibited by adding Cd^{2+} (more than 1.0 (mg/kg) dried soil), As^{5+} (more than 30 mg /kg dried soil), Cu^{2+}(more than 500 (mg/kg) dried soil), Pb^{2+}(more than 400 (mg/kg) dried soil) and Cr^{3+}(more than 200 (mg/kg) dried soil). The lowest metal concentration (LOMC) of different metals at which the population of SRB and SRA were influenced was different. The responses of population of SRB and SRA in different soils to same metal were different. The population of SRB and SRA was increased by adding Pb^{2+}(200 (mg/kg) dried soil) in Huangsong paddy soil, Red paddy soil, while there was no effect on it in Purple paddy soil. The recovery times of the population of SRB and SRA were different for different types soils as well as levels of heavy metal contamination. Generally, the higher the contamination of heavy metal applied, the longer the time needed. The biological activities of the population of SRB and SRA were so low in Red paddy soil and Huangsong paddy soil due to adding of Cr^{3+}(1600 (mg/kg) dried soil) that the recovery of population of SRB and SRA by soils themselves was almost impossible. Thebiological activity of the Purple paddy soil were also low but it could recovery partially itself. The contaminatedcritical point for same heavy mental, which inhibited the population of SRB and the SRA, also varied a lot for different types of paddy soils.

Keywords:

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