环境科学学报
ACTA SCIENTIAE CIRCUMSTANTIAE

研究报告

卢冠男,夏梦洁,贾丹阳,和文祥,吕家珑,韦革宏.我国14种典型土壤脲酶、脱氢酶活性对汞胁迫的响应[J].环境科学学报,2014,34(7):1788-1793

我国14种典型土壤脲酶、脱氢酶活性对汞胁迫的响应

Response of mercury stress on soil urease and dehydrogenase activities in 14 major soil types in China

关键词：Hg 脲酶 脱氢酶 土壤类型 生态剂量

基金项目：国家高技术研究发展计划项目（No.2012AA101402）；公益性行业（农业）科研专项（No.200903015）；西北农林科技大学基本科研业务费科研创新重点项目（No.ZD2013012）；西北农林科技大学大学生科创项目

作 者 单位

卢冠男 1. 西北农林科技大学资源环境学院, 杨凌 712100;2. 农业部西北植物营养与农业环境重点实验室, 杨凌 712100

夏梦洁 西北农林科技大学资源环境学院, 杨凌 712100

贾丹阳 西北农林科技大学资源环境学院, 杨凌 712100

和文祥 1. 西北农林科技大学资源环境学院, 杨凌 712100;2. 农业部西北植物营养与农业环境重点实验室, 杨凌 712100

吕家珑 1. 西北农林科技大学资源环境学院, 杨凌 712100;2. 农业部西北植物营养与农业环境重点实验室, 杨凌 712100

韦革宏 西北农林科技大学生命学院, 杨凌 712100

摘要：Hg作为环境的主要污染重金属之一，其对土壤酶的影响是表征其环境效应的重要方面，结果可为土壤环境监测等提供生物学依据.因此，本文通过室内模拟试验，较系统地分析了全国14种主要类型18个土样的脲酶和脱氢酶活性在Hg胁迫下的响应.结果表明，Hg会抑制土壤酶活性，其降幅随土壤类型的不同有明显差异；随着Hg含量的升高，土壤脲酶和脱氢酶活性均显著降低；模型$U=A/(1+B\times C)$（U）与汞含量（C）之间的关系，揭示出土壤脲酶和脱氢酶在一定程度上可监测土壤Hg污染的程度，且机理为完全抑制（包括竞争性抑制和非竞争性抑制）作用.同时，实验获得的供试土样脲酶的生态剂量（ED_{10}）范围为0.08~0.77 mg·kg^{-1}，脱氢酶ED_{10}范围为0.11~2.58 mg·kg^{-1}，从土壤酶角度获得的土壤汞轻度污染临界值为0.08 mg·kg^{-1}，此值要小于国家土壤质量标准中的二级标准.有机质、pH、CEC和粘粒显著影响了汞与土壤脱氢酶的关系，上述4个土壤性状参数值越高，汞对土壤酶的毒害作用就越弱；酸性土壤中汞的毒害作用强于碱性土壤.表明在我国主要土壤类型上，土壤脲酶、脱氢酶对Hg毒性均较为敏感，可在更广范围内作为Hg污染程度的监测指标之一.

Abstract: Mercury is one of the major heavy metal pollutants in the environment. Investigation of the relationship between mercury (Hg) concentration and soil enzymes activities provides the biological basis for soil environmental monitoring. 18 samples from 14 major soil types in China were selected to analyze soil urease and dehydrogenase activities under Hg stress in laboratory simulation. The results showed that Hg generally inhibited ($p<0.05$) soil enzyme activities, and the inhibited rate was significantly different with soil types. Soil urease and dehydrogenase activities decreased significantly ($p<0.05$) with the increasing Hg concentration. Model $U=A/(1+B\times C)$ could well describe the relationship between soil enzymatic activities (U) and Hg concentration (C). Soil urease and dehydrogenase could be good indexes to monitor Hg pollution level for major soil types in China. The reaction mechanism of Hg on soil urease and dehydrogenase activities was complete inhibition, including competitive and noncompetitive inhibition. ED_{10} value of urease and dehydrogenase was 0.08~0.77 mg·kg^{-1} and 0.11~2.58 mg·kg^{-1}, respectively, and the critical concentration value for slight soil pollution was 0.08 mg·kg^{-1}. Soil organic matter, pH, CEC and clay content were the most significant factors to influence the relationship between soil dehydrogenase and Hg. Soil urease and dehydrogenase activities were both sensitive to Hg and could be used as indicator to monitor soil Hg pollution in wide regions of China.

Key words: mercury(Hg) urease dehydrogenase soil type ecological dose