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Interactions of Penicillium griseofulvum with inorganic and organic substrates: vanadium, lead and hexachlorocyclohexane

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Soil is an essential and non-renewable resource for human beings and ecosystems. In recent years, anthropogenic activities mainly related to hydrocarbon fuel combustion, mining and industrial activities have increased the levels of vanadium in the environment, raising concern over its spread. Vanadium may be essential for some bacteria and fungi, but can have toxic effects at high concentrations. The pesticide lindane or γ-hexachlorocyclohexane (γ-HCH) and another two isomers of hexachlorocyclohexane (HCH), α-HCH, and β-HCH, were included as persistent organic pollutants in the Stockholm Convention in 2008, and their worldwide spread and toxic effects on organisms are severe environmental problems. Fungi play important roles in soil and can survive in high concentrations of toxic elements and pesticides by possessing mechanisms for the degradation, utilization and transformation of organic and inorganic substrates. The transformation of potentially toxic elements (PTEs), and degradation of chlorinated pesticides and other persistent organic pollutants may provide environmentally-friendly and economical approaches for environmental management and restoration. In this work, we have investigated the tolerance of a soil fungal species, Penicillum griseofulvum, to different hexachlorocyclohexane (HCH) isomers, α-HCH, β-HCH, δ-HCH and γ-HCH or lindane, and two PTEs, vanadium and lead in relation to growth responses and biotransformation. P. griseofulvum was isolated from soils with high levels of PTEs (including vanadium and lead), and HCH residues. P. griseofulvum was able to tolerate vanadium concentrations up to 5 mM, combinations of 2.5 mM vanadium and lead compounds, and was able to grow in the presence of a 4 mg L-1 mixture of α-HCH, β-HCH, δ-HCH and γ-HCH, and degrade these substrates. Tolerance mechanisms may explain the occurrence of fungi in polluted habitats: their roles in the biotransformation of metals and persistent organic pollutants may provide opportunities for bioremediation. (287 words)