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Abstract

Hexachlorocyclohexane (HCH) isomers are reported to persist in the environment long after their usage is discontinued. 3OHXURWXVÀRULGD ZDV IRXQG WR EH...
SHUVLVWHQW LVRPHUV LQGLYLGXDOO\ DV ZHOO DV D PL[WXUH LQ D 5DSHU¶V FRP...
FRPSOHWHO\ ZKHUHDV RWKHU LVRPHUV GHJUDGHG 7KH GHJUDGDWLRQ U...
7KH P\FHOLXP ELRPDVV ZDV IUHH IURP +&+ UHVLGXHV EXW DFFXPXODWHG DER...
Presence of intermediate metabolites was not detected indicating complete mineralization of HCH isomers. Ability of 3 ÀRULGD to degrade HCH isomers was further studied in soil by amendment with spent mushroom substrate (SMS).
606 DGGLWLRQ FRXOG PDUJLQDOO\ LQFUHDVH GHJUDGDWLRQ RI . DQG / +&+
RI +&+ :KHQ WKH VWXG\ ZDV UHSHDWHG VLPLODU WUHQG ZDV REVHUYHG 7KH
439-570 days in un-amended soil while 37-42 days in SMS amended soil. For other 3 stable isomers the half-life was reduced from 686-828 to 88-125 days by SMS amendments. These results indicate that SMS from 3 ÀRULGD cultivation can be utilized for bioremediation of HCH contaminated site.

Keywords: Degradation; Hexachlorocyclohexane; Metabolites; Pleurotus orida; Spent mushroom substrate

Abbreviations: HCH: Hexachlorocyclohexane; LOD: Limit of Detection; P: Pleurotus

Introduction

[illegible — overlapping text] ...is given for any purpose the other isomers are likely to enter as

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(purity 99.9%), 1,2,4,5-tetrachlorobenzene (purity 99.4%), 1,2,3,5-tetrachlorobenzene (purity 97.5%), 1,2,3,4-tetrachlorobenzene (purity 99.0%), and pentachlorobenzene (purity 99.8%) were procured from Sigma-Aldrich, Germany. All chemicals and reagents used were of analytical grade.

Standard solution

Stock solutions (1000 µg ml^{-1}) of -, -, -, -HCH and all the metabolites were prepared in n-hexane. Working standards were

mode (mass acquisition range m/z 40-450) using ionization energy of 70 eV. e gas chromatograph was operated in split less mode with injector temperature of 250°C and ion source temperature of 200°C. A capillary column, Agilent DB-5ms (30 m × 0.25 mm i.d. 0.25 µm; stationary phase, 5% phenyl 95% methyl polysiloxane) was used for analy-

had degraded whether treated individually or as a mixture with other isomers. e mycelium biomass from -HCH treated medium was also free from its residues. -HCH, which is known to be highly stable in the environment, also degraded very fast, with about 91% being lost from the treated medium a er 20 days. A small amount (3.23%) of -HCH was found adsorbed by the mycelium. However degradation of other isomers, i.e. - and -HCH was not as fast as the other 2 isomers. About 65% applied -HCH was lost from medium when applied individually, with 2.91% accumulation in the mycelium. When treated in combination with other isomers 67.3% was lost from medium, but substantially high, about 10% was recovered from the mycelium. In case of -HCH about 35% was recovered from medium plus mycelium when treated individually and about 42% was recovered when treated in combination (Table 2).

A er a period of 30 days complete degradation of -HCH had occurred from the treated medium both from individual and combination treatment with no accumulation in the mycelium. Residues of the other 3 isomers in the medium and mycelium together for -, - and -HCH were 8.99, 8.77 and 11.50%, respectively a er 30 days when treated individually. ese 3 isomers seemed to degrade faster when treated as a mixture compared to individual treatment. From combination treatment 4.6 and 1.58%, - and -HCH, respectively was recovered from medium and mycelium together. Only 0.46% added -HCH was recovered from medium and the mycelium was residue free from combination treatment a er 30 days. e results show that -HCH degradation was fastest among the 4 isomers and the degradation rate was not a ected whether the treatment was carried out individually or in combination with other isomers. For the other isomers slightly faster degradation was observed in the initial stages from individual treatment. But a er 30 days it had reversed, i.e. degradation of -, - and -HCH isomers was faster when they were treated in combination. But overall it was observed that P. orida not only degraded - and -HCH, it degraded the more persistent - and -isomers equally fast. e analysis of extracts from medium/mycelium did not show any additional peak corresponding to any of the metabolites mentioned above. is was also con rmed by analyzing the extracts by GC-MS. Degradation of HCH isomers in Raper's complete medium is given in Figure 1.

Degradation of HCH isomers in soil

Degradation of HCH isomers was slow in soil without SMS compared to soil with SMS. It was also observed that there was di erence in the rate of degradation of all isomers in the presence of SMS (Table 3). In the initial 30 days period there was no signi cance di erence in the rate of degradation of all isomers. But a er 40 days period about 12-17% of -, - and -HCH was lost from soil while about 38% -HCH was lost. A er a period of 60 days about 61-67% -HCH was lost from soil with SMS compared to about 20-30% loss of the other isomers. In soil without SMS the loss of HCH residues were about 4-9% in 60 days. e experiment was repeated and a similar trend was observed (Table 4). Degradation of HCH isomers from soil is given in Figure 2.

Dissipation kinetics of HCH isomers in soil

Residue dissipation of HCH isomers was studied by subjecting the data to rst order kinetics; $C_t = C_0 e^{-kt}$, where C_t is the concentration at time t; C_0 is the initial concentration, k is the rate constant for dissipation and t is the time. e half-life was calculated from the k value using the formula; $t_{1/2} = \ln(2)/k$. It was observed that the dissipation of all HCH isomers followed rst order rate kinetics. In soil without SMS the half-life of degradation of -, - and -HCH was in the range of 748-828 days. But when SMS was added to the soil it was substantially reduced

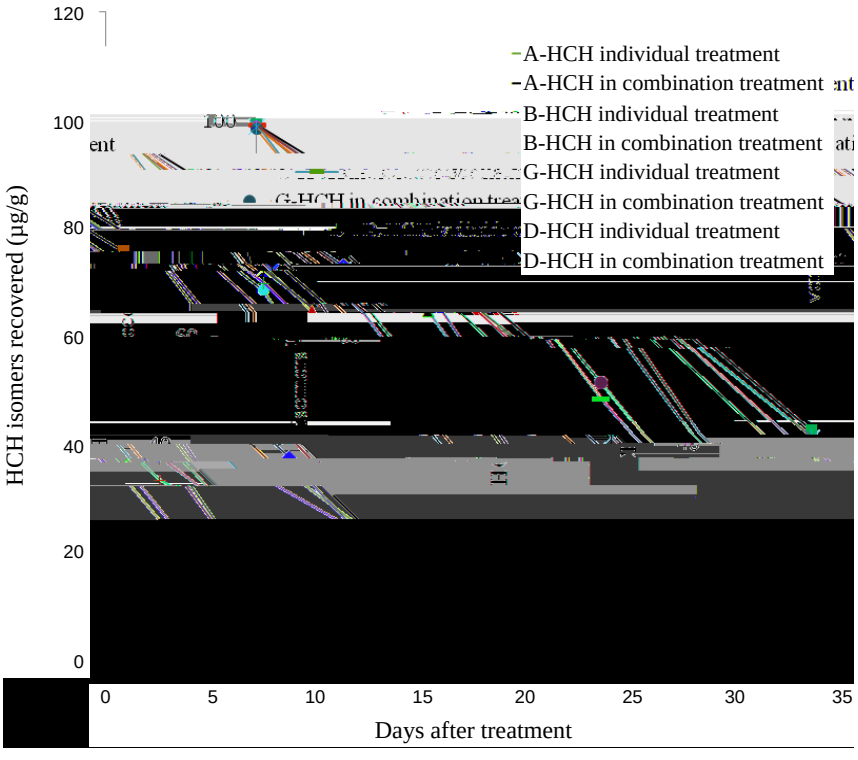

Figure 1: , Q Y L W U R degradation of HCH isomers individually and as mixture of 4 isomers.

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