# Lindane

| Title | Perspectives of lindane (γ-hexachlorocyclohexane) biodegradation from the environment: a review |
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| Author Name | Dharmender Kumar and Rochika Pannu |
| Journal Name | Bioresources and Bioprocessing |
| Year | 2018 |
| Volume and Issue | 5:29 |
| Abstracts | This review describes the biodegradation of Lindane *(γ-hexachlorocyclohexane*, γ-HCH) from the diverse sources. Environmental degradation of γ-HCH has been described in terms of integrated biological approaches such as *metagenomics*, cloning, *phytoremediation, nanobiodegradation*, and *biosrfactants*, genes and enzymes responsible for γ-HCH degradation and exploration of new strains of γ-HCH-degrading microbes from different environmental sources. *Metagenomics-based* approaches help in the identification and isolation of new genes from the uncultivable sources and provide insights for future research. There is potential in the elucidation of pathways of degradation of persistent organic pollutants (POPs) from environment by the microorganisms. This is possible by means of new/improved microbial species. The *behavior* of isolated strains and the microorganisms when present in community is altogether different. Therefore, there is a need to develop new technology which will identify the minor component of the microbial community involved in degradation because the minor part might have profound effect on degradation. This is mediated by the biological activity of the microbial system. |
| Keywords | Microbial degradation; Metagenomics; Phytoremediation; Microbial Community; Lindane (γ-hexachlorocyclohexane, γ-HCH) |

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| **Title** | **Lindane dissipation in a biomixture: Effect of soil properties and bioaugmentation** |
| **Author Name** | Juliana M.Saez, Ana L.Bigliardo, EnzoE.Raimondo, Gabriela E.Briceño, Marta A.Polti&Claudia S.Benimeliae |
| **Journal Name** | Ecotoxicology and Environmental Safety |
| **Year** | 2018 |
| **Volume and Issue** | Volume 156 |
| **Pages** | 97-105 |
| **Abstracts** | The *biomixture* is the major constituent of a *biopurification* system and one of the most important factors in its efficiency; hence the selection of the components is crucial to ensure the efficient pesticides removal. Besides, *bioaugmentation* is an interesting approach for the optimization of these systems. A mixed culture of the fungus *Trametesversicolor* SGNG1 and the *actinobacteria Streptomyces* sp. A2, A5, A11, and M7, was designed to inoculate the *biomixtures*, based on previously demonstrated *ligninolytic* and pesticide-degrading activities and the absence of antagonism among the strains. The presence of *lindane* and/or the *inoculum* in the *biomixtures* had no significant effect on the development of *culturable* microorganisms regardless the soil type. The consortium improved *lindane* dissipation achieving 81–87% of removal at 66 d of incubation in the different *biomixtures*, decreasing *lindane* half-life to an average of 24 d, i.e. 6-fold less than t1/2 of *lindane* in soils. However, after recontamination, only the *bioaugmentedbiomixture* of *silty* loam soil enhanced *lindane* dissipation and decreased the t1/2 compared to *non-bioaugmented*. The *biomixture* formulated with silty loam soil, sugarcane *bagasse*, and peat, inoculated with a *fungal-actinobacterial* consortium, could be appropriate for the treatment of *agroindustrial* effluents contaminated with *organochlorine* pesticides in *biopurification* systems. |
| **Keywords** | Biomixture; Pesticides; Bioaugmentation; Biopurification system; Actinobacteria; Fungi |

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| **Title** | **Microbial-enhanced lindane removal by sugarcane (Saccharumofficinarum) in doped soil-applications in phytoremediation and bioaugmentation** |
| **Author Name** | Jaseetha Abdul Salam, Mohammed A.A.Hatha&Nilanjana Das |
| **Journal Name** | Journal of Environmental Management |
| **Year** | 2017 |
| **Volume and Issue** | 193 |
| **Pages** | Pages 394-399 |
| **Abstracts** | The aim of this study was to examine the effect of *lindane*-degrading yeast on the growth and lindane uptake by *Saccharum* sp., in doped garden soils. The rhizosphere of *Saccharum* plant was amended with yeast Candida VITJzN04 by root-inoculation. The bio-augment yeast was applied in two different forms viz., *planktonic* form and cells immobilized on sugarcane-bagasse, in the pot experiments. Garden soils (lindane~100 mg/kg) exposed to various treatments were monitored for a period of 30 days, for residual *lindane* by gas-chromatography analysis. The *lindane*-removal rates in soil were expressed in terms of half-life period and were recorded as 13.3 days (yeast), 43.3 days (*Saccharum),* 9.8 days (free yeast-plant) and 7.1 days (immobilized yeast-plant). Additionally, Candida sp., was also identified as a plant growth promoting yeast due to its ability to produce growth hormone and *solubilize* insoluble phosphates in the soil for better uptake by the plant species. Bio-stimulation of the soil with yeast immobilized on sugarcane *bagasse* further enhanced the total yeast activity in the soil which in turn had a positive influence on *lindane*-removal. Combined treatment with *bagasse* immobilized yeast and plant showed the best *lindane* degradation. Results suggested that the synergistic activity of plant and yeast resulted in fast and efficient degradation of *lindane*. Thus, it can be concluded that *Saccharum* plant in combination with Candida VITJzN04 is an effective alternative for the conventional remediation strategies. |
| **Keywords** | Bioaugmentation; Candida VITJzN04; Immobilization; Lindane; Phytoremediation; Saccharum sp. |

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| **Title** | **Targeting of detoxification potential of microorganisms and plants for cleaning environment polluted by organochlorine pesticides** |
| **Author Name** | M.V.Kurashvili, G.S.Adamia, L.L.Amiranashvili, T.I.Ananiasvili, T.G.Varazi, M.V.Pruidze, M.S.Gordeziani&G.A.Khatisashvili |
| **Journal Name** | Annals of Agrarian Science |
| **Year** | 2016 |
| **Volume and Issue** | 14,3 |
| **Pages** | 222-226 |
| **Abstracts** | The goal of presented work is the development phytoremediation method targeted to cleaning environment polluted with organochlorine pesticides, based on joint application of specially selected plants and microorganisms. Initial degradation of pesticides carry out by microorganisms; the forming dehalogenated products easily uptake by the plants and undergo oxidative degradation via plant detoxification enzymes. This approach can complete degradation of toxicants and their mineralization into nontoxic compounds. In the presented work the results of using selected strains from genera Pseudomonas and plants phytoremediators in the model experiments are given. It has been shown that the using developed technological approach effectively decreased degree of pollution in artificially polluted soil samples. |
| **Keywords** | Detoxifidation potential; Organochlorine pesticides; Persistent organic; Pollutants; Phytoremediation technologies; Microorganisms |

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| **Title** | **Is Vigna radiata (L.) R. Wilczek a suitable crop for Lindane contaminated soil?** |
| **Author Name** | Vishal Tripathi, Rama Kant Dubey, H.B. Singh, Nandita Singh, P.C. Abhilash |
| **Journal Name** | Ecological Engineering |
| **Year** | 2014 |
| **Volume and Issue** | Volume 73 |
| **Pages** | 219 - 223 |
| **Abstracts** | Lindane (γ-hexachlorocyclohexane) is an organochlorine pesticide recently included in the Stockholm list of persistent organic pollutants for global elimination. However, India is still allowed to use Lindane for combating vector borne diseases. Because of its large scale utilization during the last few decades, Lindane residue is reported from almost all agricultural soils of India. So there is an immediate need to monitor the accumulation of Lindane residue in crop plants growing in contaminated systems and suitable strategies should be taken to prevent the possible entry of Lindane in food chain. Therefore, in the present study, we studied the accumulation and translocation of Lindane in Vigna radiata (L.) R. Wilczek (Mung bean), a widely grown legume in India as a cheap source of protein. The test plant was grown in four different concentrations of Lindane viz. 5, 10, 15 and 20 μg g−1 soils and harvested at 15 and 45 days and at maturity. The experimental results showed that irrespective of the exposure days, the accumulation of Lindane in plant parts were linearly correlated (r2 = 0.915) with the Lindane concentration in soil. However, the Lindane concentration in soil significantly reduced the growth and yield (number of pods, pod length, number of seeds and seed weight) of the test plants at 95% confidence level (α = 5). At maturity, the concentration of Lindane in whole plant (root + shoot + leaf + seed) growing at four different concentrations were reached up to 3.8, 9.4, 13.5 and 17.79 μg g−1 dry matter, respectively. Worryingly, Lindane residue was found in the seeds of test plants grown at 10, 15 and 20 μg g−1 soils and the concentrations were detected as 0.2, 0.4 and 0.89 μg g−1 dry seed, respectively. Most importantly, the residue level detected in the edible part was higher than the maximum residue limit set by WHO and Codex Alimentarious Commission (0.1 μg g−1). Thus our study suggests that Mung bean is not a suitable crop for medium to high level Lindane contaminated soil. |
| **Keywords** | Persistent organic pollutants, Organochlorine pesticide, Lindane, Vigna radiata (L.) R. Wilczek, Phytoaccumulation, Maximum residue limit |

| Title | Phytoextraction and dissipation of Lindane by Spinacia oleracea L. |
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| Author Name | Rama Kant Dubey, Vishal Tripathi, Nandita Singh, P.C. Abhilash |
| Journal Name | Ecotoxicology and Environmental Safety |
| Year | 2014 |
| Volume and Issue | Volume 109 |
| Pages | 22 - 26 |
| Abstracts | Remediation and management of organochlorine pesticide (OCPs) contaminated soil is becoming a global priority as they are listed in the Stockholm list of persistent organic pollutants (POPs) for global elimination. Lindane is a OCPs candidate recently included in the Stockholm list. However, India has an exemption to produce Lindane for malaria control. Because of its widespread use during the last few decades, Lindane contaminated soils are found in almost all parts of India. Since phytoremediation is widely acknowledged as an innovative strategy for the clean-up of contaminated soils; the present study was aimed to evaluate the phytoextraction and dissipation of Lindane by a leafy vegetable Spinacia oleracea L (Spinach). The test plant was grown in different concentrations of Lindane (5, 10, 15 and 20 mg kg−1) and harvested at 10, 30 and 45 days. At 45 days, the concentrations of Lindane in root and leaf of Spinach growing in four different concentrations were reached up to 3.5, 5.4, 7.6 and 12.3 mg kg−1 and 1.8, 2.2, 3 and 4.9 mg kg−1, respectively. There was a significant difference ($p<0.01$) in the dissipation of Lindane in vegetated and non-vegetated soil. Moreover, the residual Lindane in four experiments was reduced to 81, 76, 69 and 61 percent, respectively. The experimental results indicate that Spinach can be used for the phytoremediation of Lindane. However, more studies are required to prevent the toxicity of harvested parts. |
| Keywords | Persistent organic pollutants; Organochlorine pesticide; Lindane; Vigna radiata (L.) R. Wilczek; Phytoaccumulation; Maximum residue limit |