



References

- Abdollahi, M., Mostafalou, S., Pournourmohammadi, S., Shadnia, S., 2004. Oxidative stress and cholinesterase inhibition in saliva and plasma of rats following subchronic exposure to malathion. *Comparative Biochemistry and Physiology Part C: Toxicol. Pharmacol.* 137, 29-34.
- Abdulsalam, S., Omale, A.B., 2009. Comparison of biostimulation and bioaugmentation techniques for the remediation of used motor oil contaminated soil. *Braz Arch Biol Technol.* 52 (3), 747-754.
- Abhilash, P., Singh, N., 2009. Pesticide use and application: an Indian scenario. *J Hazard Mater.* 165, 1-12.
- Abhilash, P.C., Srivastava, S. and Singh, N., 2011. Comparative bioremediation potential of four rhizospheric microbial species against lindane. *Chemosphere.* 82, 56-63.
- Abraham, J., Silambarasan, S., 2016. Biodegradation of chlorpyrifos and its hydrolysis product 3, 5, 6-trichloro-2-pyridinol using a novel bacterium *Ochrobactrum* sp. *JAS2: A proposal of its metabolic pathway. Pestic Biochem Physiol.* 126, 13-21.
- Adhikari, S., Chattopadhyay, P., Ray, L., 2010. Biosorption of Malathion by immobilized cells of *Bacillus* sp. S14. *Chem Spec Bioavailab* 22, 271-276.
- Affam, A.C., Chaudhuri, M., Kutty, S.R.M., Muda, K., 2014. UV Fenton and sequencing batch reactor treatment of chlorpyrifos, cypermethrin and chlorothalonil pesticide wastewater. *Inter Biodeter Biodegr.* 93, 195-201.
- Ahmad, F., Iqbal, S., Anwar, S., Afzal, M., Islam, E., Mustafa, T. and Khan, Q.M., 2012. Enhanced remediation of chlorpyrifos from soil using ryegrass (*Lolium multiflorum*) and chlorpyrifos-degrading bacterium *Bacillus pumilus* C2A1. *J. Hazard Mater.* 237, 110-115.
- Aktar, W., Sengupta, D., Chowdhury, A., 2009. Impact of pesticides use in agriculture: their benefits and hazards. *Interdiscip Toxicol.* 2, 1-12.

- Alavanja, M.C., Hoppin, J.A., Kamel, F., 2004. Health effects of chronic pesticide exposure: cancer and neurotoxicity. *Annu. Rev. Public Health*, 25, 155-197
- Alekseeva T, Prevot V, Sancelme M, Forano C., Besse-Hoggan P, 2011. Enhancing atrazine biodegradation by *Pseudomonas* sp. strain ADP adsorption to Layered Double Hydroxide bio-nanocomposites. *J Hazard Mater*, 191(1), 126-135.
- Alexander, R., Jayes, A., Maloiy, G., Wathuta, E., 1979. Allometry of the limb bones of mammals from shrews (Sorex) to elephant (Loxodonta). *J. Zool.* 189, 305-314.
- Andrews, J.F., 1968. A mathematical model for the continuous culture of microorganisms utilizing inhibitory substrates. *Biotechnol. Bioeng.*10, 707-723.
- Anjum, R., Rahman, M., Masood, F., Malik, A., 2012. Bioremediation of pesticides from soil and wastewater. In *Environmental Protection Strategies for Sustainable Development*. 295-328.
- Annabi, C., Fourcade, F., Soutrel, I., Geneste, F., Floner, D., Bellakhal, N., Amrane, A., 2016. Degradation of enoxacin antibiotic by the electro-Fenton process: Optimization, biodegradability improvement and degradation mechanism. *J Environ Manage.* 165, 96-105
- APHA, AWWA, WEF, 2005. *Standard Methods for the Examination of Water and Wastewater*, twenty-firsted. American Public Health Association, Washington DC, USA,
- Aresta, A., Marzano, C.N., Lopane, C., Corriero, G., Longo, C., Zambonin, C., Stabili, L., 2015. Analytical investigations on the lindane bioremediation capability of the demosponge *Hymeniacidon perlevis*. *Mar. Pollut. Bull.*90, 143-149.
- Arshad, M., Saleem, M., Hussain, S., 2007. Perspectives of bacterial ACC deaminase in phytoremediation. *Trends Biotechnol.*25, 356-362.
- Asadi, A., Zinatizadeh, A.A.L., Sumathi, S., 2012. Simultaneous removal of carbon and nutrients from an industrial estate wastewater in a single up-flow aerobic/anoxic sludge bed (UAASB) bioreactor. *Water Res*, 46, 4587-4598.
- Azmi, M.A., Naqvi, S., Azmi, M.A., Aslam, M., 2006. Effect of pesticide residues on health and different enzyme levels in the blood of farm workers from Gadap (rural area) Karachi-Pakistan. *Chemosphere* 64, 1739-1744.

- Azmy, A.F., Saafan, A.E., Essam, T.M., Amin, M.A., Ahmed, S.H., 2015. Biodegradation of Malathion by *Acinetobacter baumannii* Strain AFA Isolated from Domestic Sewage in Egypt. *Biodegradation*, 117465.
- Bailey, J., Ollis, D., 1986. *Fundamentals of Bio-chemical Engineering*. McGraw-Hill, New York, USA.
- Beard, J., Collaboration, A.R.H.R., 2006. DDT and human health. *Sci Total Environ*.355, 78-89.
- Bellucci, M., Ofițeru, I.D., Graham, D.W., Head, I.M., Curtis, T.P., 2011. Low-dissolved-oxygen nitrifying systems exploit ammonia-oxidizing bacteria with unusually high yields. *Appl Environ Microbiol*. 77 (21), 7787-7796.
- Beltran-Heredia, J., Torregrosa, J., Dominguez, R., Garcia, J., 2000. Treatment of black-olive wastewaters by ozonation and aerobic biological degradation. *Water Research*. 34, 3515-3522.
- Bhalerao, T.S., Puranik, P.R., 2007. Biodegradation of organochlorine pesticide, endosulfan, by a fungal soil isolate, *Aspergillus niger*. *Inter Biodeter.Biodegr*.59, 315-321.
- Bonan, G.B., 2008. Forests and climate change: forcings, feedbacks, and the climate benefits of forests. *Science* 320, 1444-1449.
- Bonner, M.R., Coble, J., Blair, A., Freeman, L.E.B., Hoppin, J.A., Sandler, D.P., Alavanja, M.C., 2007. Malathion exposure and the incidence of cancer in the agricultural health study. *Am J Epidemiol*. 166, 1023-1034.
- Braig, K., Otwinowski, Z., Hegde, R., Boisvert, D.C., Joachimiak, A., Horwich, A.L., Sigler, P.B. 1994. The crystal structure of the bacterial chaperonin GroEL at 2.8 Å. *Nature*. 371,578.
- Bramhachari, P.V., Reddy, D.R.S., Kotresha, D., 2016. Biodegradation of catechol by free and immobilized cells of *Achromobacterxylosoxidans* strain 15DKVB isolated from paper and pulp industrial effluents. *Biocatal Agric Biotechnol*. 7, 36-44.
- Bretau, S., Toutant, J.-P., Saglio, P., 2000. Effects of carbofuran, diuron, and nicosulfuron on acetylcholinesterase activity in goldfish (*Carassius auratus*). *Ecotoxicol Environ Saf*.47, 117-124.

- Brusick, D.J., 1994. An assessment of the genetic toxicity of atrazine: relevance to human health and environmental effects. *Mutat Res Genet Toxicol Environ Mutagen.*317, 133-144.
- Bsat, N., Herbig, A., Casillas-Martinez, L., Setlow, P., Helmann, J.D., 1998. *Bacillus subtilis* contains multiple Fur homologues: identification of the iron uptake (Fur) and peroxide regulon (PerR) repressors. *Mol. Microbiol.* 29 (1), 189-198.
- Burns, J., 1975a. Background staining and sensitivity of the unlabelled antibody-enzyme (PAP) method. Comparison with the peroxidase labelled antibody sandwich method using formalin fixed paraffin embedded material. *Histochemistry* 43, 291-294.
- Burns, R., 1975b. Factors affecting pesticide loss from soil. *Soil biochemistry.*103-141
- Castresana, J. Selection of conserved blocks from multiple alignments for their use in phylogenetic analysis. *Mol. Biol. Evol.* 2000, 17, 540-552.
- Celis, E., Elefsiniotis, P., Singhal, N., 2008. Biodegradation of agricultural herbicides in sequencing batch reactors under aerobic or anaerobic conditions. *Water Research.* 42 (12), 3218-3224.
- Cesar, A., Ros, M., 2013. Long-term study of nitrate, nitrite and pesticide removal from groundwater: A two-stage biological process. *Inter Biodeter.Biodegr.* 82, 117-123.
- Chen, S., Geng, P., Xiao, Y. and Hu, M., 2012. Bioremediation of β -cypermethrin and 3-phenoxybenzaldehyde contaminated soils using *Streptomyces aureus* HP-S-01. *Appl Microbiol Biotechnol.* 94, 505-515.
- Cheung, K., Gu, J.-D., 2007. Mechanism of hexavalent chromium detoxification by microorganisms and bioremediation application potential: a review. *Inter Biodeter Biodegr.*59, 8-15.
- Chirnside, A.E., Ritter, W.F., Radosevich, M., 2009. Biodegradation of aged residues of atrazine and alachlor in a mix-load site soil. *Soil Biol.Biochem.* 41, 2484-2492.
- Chowdhury, A., Pradhan, S., Saha, M., Sanyal, N., 2008. Impact of pesticides on soil microbiological parameters and possible bioremediation strategies. *Indian J Microbiol.* 48, 114-127.
- Colborn, T., vom Saal, F.S., Soto, A.M., 1993. Developmental effects of endocrine-disrupting chemicals in wildlife and humans. *Environ Health Perspect.*101, 378.

- Cycon, M., Wojcik, M., Piotrowska-Seget, Z., 2009. Biodegradation of the organophosphorus insecticide diazinon by *Serratia sp.* and *Pseudomonas sp.* and their use in bioremediation of contaminated soil. *Chemosphere* 76, 494-501.
- Cycon, M., Zmijowska, A., Wojcik, M., Piotrowska-Seget, Z., 2013. Biodegradation and bioremediation potential of diazinon-degrading *Serratia marcescens* to remove other organophosphorus pesticides from soils. *J. Environ. Manage.* 117, 7-16.
- Damalas, C.A. and Eleftherohorinos, I.G., 2011. Pesticide exposure, safety issues, and risk assessment indicators. *Int J Environ Res Public Health*, 8(5), 1402-1419.
- Das, N., 2015. Removal of atrazine from aqueous environment using immobilized *Pichia kudriavzevii* Atz-EN-01 by two different methods. *Inter Biodeter Biodegr* 104, 53-58.
- Dave, K.I., Lauriano, C., Xu, B., Wild, J.R., Kenerley, C.M., 1994. Expression of organophosphate hydrolase in the filamentous fungus *Gliocladium virens*. *Appl Microbiol Biotechnol.* 41, 352-358.
- Debasmita N., Rajasimman M., 2013. Optimization and kinetics studies on biodegradation of atrazine using mixed microorganisms. *Alex Eng J.* 52(3) 499.
- Deng, S., Chen, Y., Wang, D., Shi, T., Wu, X., Ma, X., Li, X., Hua, R., Tang, X., Li, Q.X., 2015. Rapid biodegradation of organophosphorus pesticides by *Stenotrophomonas sp.* G1. *J. Hazard Mater.* 297, 17-24.
- Deng, X., Huang, J., Rozelle, S., Uchida, E., 2006. Cultivated land conversion and potential agricultural productivity in China. *Land use policy* 23, 372-384.
- Denver, D.R., Swenson, S.L. and Lynch, M., 2003. An evolutionary analysis of the helix-hairpin-helix superfamily of DNA repair glycosylases. *Mol. Biol. Evol.* 20, 1603-1611.
- Doherty, A.J., Serpell, L.C., Ponting, C.P., 1996. The helix-hairpin-helix DNA-binding motif: a structural basis for non-sequence-specific recognition of DNA. *Nucleic Acids Res.* 24, 2488-2497.
- Douglass J.F., Radosevich M., Tuovinen O.H., 2015. Molecular analysis of atrazine-degrading bacteria and catabolic genes in the water column and sediment of a created wetland in an agricultural/urban watershed. *Ecol Eng*, 83, 405-412.
- Douglass, J.F., Radosevich, M., Tuovinen, O.H., 2014. Mineralization of atrazine in the river water intake and sediments of a constructed flow-through wetland. *Ecol. Eng.* 72, 35-39.

References

- Drufovka, K., Danevcic, T., Trebse, P., Stopar, D., 2008. Microorganisms trigger chemical degradation of diazinon. *Inter Biodeter.Biodegr.*62, 293-296.
- Du J., Zhang Y., Ma Y., Li J., Zhang Q., 2011. Simulation study of atrazine-contaminated soil biodegradation by strain W16. *Procedia Environ Sci*, 11, 1488-1492.
- Edwards, H., Rehm, H., 1989. Semi-continuous and continuous degradation of phenol by *Pseudomonas putida* P8 adsorbed on activated carbon. *Appl Microbiol Biotechnol* 30, 312-317
- Eqani, S.A.M.A.S., Malik, R.N., Katsoyiannis, A., Zhang, G., Chakraborty, P., Mohammad, A. Jones, K.C., 2012. Distribution and risk assessment of organochlorine contaminants in surface water from River Chenab, Pakistan. *J Environ Monit.* 14(6), 1645-1654.
- Eskenazi, B., Bradman, A., Castorina, R., 1999. Exposures of children to organophosphate pesticides and their potential adverse health effects. *Environ Health Perspect.*107, 409.
- Fang H. Lian J., Wang H., Cai L., Yu Y., 2015. Exploring bacterial community structure and function associated with atrazine biodegradation in repeatedly treated soils. *J Hazard Mater*, 286, 457-465.
- Fargione, J., Hill, J., Tilman, D., Polasky, S., Hawthorne, P., 2008. Land clearing and the biofuel carbon debt. *Science.* 319, 1235-1238.
- Felsot, A.S., 1996. Options for cleanup and disposal of pesticide wastes generated on a small scale. *J Environ Sci Health B.* 31(3), 365-381
- Follett, R.F., 2001. Soil management concepts and carbon sequestration in cropland soils. *Soil Tillage Res.* 61(1), 77-92.
- Freeman, L.E.B., Bonner, M.R., Blair, A., Hoppin, J.A., Sandler, D.P., Lubin, J.H., Dosemeci, M., Lynch, C.F., Knott, C., Alavanja, M.C., 2005. Cancer incidence among male pesticide applicators in the Agricultural Health Study cohort exposed to diazinon. *Am J Epidemiol.* 162, 1070-1079.
- Friha, I., Karray, F., Feki, F., Jlaiel, L., Sayadi, S., 2014. Treatment of cosmetic industry wastewater by submerged membrane bioreactor with consideration of microbial community dynamics. *Inter Biodeter.Biodegr.* 88, 125-133.
- Fuhr, P., Agostino, R., Hallett, M., 1991. Spinal motor neuron excitability during the silent period after cortical stimulation. *Electroencephalogr Clin Neurophysiol.*81, 257-262.

- Fulazzaky, M.A., Abdullah, N.H., Yusoff, A.R.M., Paul, E., 2015. Conditioning the alternating aerobic–anoxic process to enhance the removal of inorganic nitrogen pollution from a municipal wastewater in France. *J Clean Prod.* 100, 195-201.
- Gaballa, A., Helmann, J.D., 1998. Identification of a Zinc-Specific Metalloregulatory Protein, Zur, Controlling Zinc Transport Operons in *Bacillus subtilis*. *J Bacteriol.* 180, 5815-5821.
- Garza-Campos B. R., Guzman-Mar J.L., Reyes L.H., Brillas E., Hernandez-Ramirez A., Ruiz-Ruiz E. J., 2014. Coupling of solar photoelectro-Fenton with a BDD anode and solar heterogeneous photocatalysis for the mineralization of the herbicide atrazine. *Chemosphere* 97, 26-33.
- Geed, S.R., Kureel, M.K., Giri, B.S., Singh, R.S., Rai, B.N., 2017. Performance evaluation of Malathion biodegradation in batch and continuous packed bed bioreactor (PBBR). *Bioresour. Technol*, 227, 56-65.
- Geed, S.R., Kureel, M.K., Shukla, A.K., Singh, R.S., Rai, B.N., 2016. Biodegradation of malathion and evaluation of kinetic parameters using three bacterial species. *Resour. Eff. Technol*, 2, S3-S11.
- Gillett, J.W., 1989. The role of terrestrial microcosms and mesocosms in ecotoxicologic research. In *Ecotoxicology: Problems and Approaches* (Springer). 367-410.
- Giri, B.S., Pandey, R.A., 2013. Biological treatment of gaseous emissions containing dimethyl sulphide generated from pulp and paper industry. *Biores Technol.* 142, 420-427.
- Goda, S.K., Elsayed, I.E., Khodair, T.A., El-Sayed, W., Mohamed, M.E., 2010. Screening for and isolation and identification of malathion-degrading bacteria: cloning and sequencing a gene that potentially encodes the malathion-degrading enzyme, carboxylestrase in soil bacteria. *Biodegradation*, 21(6), 903-913.
- Gold, S., Rangarajan, A., 1996. A graduated assignment algorithm for graph matching. *IEEETrans .PatternA.* 18, 377-388.
- Grcic I., Muzic M., Vujevic D., Koprivanac N., 2009. Evaluation of atrazine degradation in UV/FeZSM-5/H₂O₂ system using factorial experimental design. *Chem Eng J*, 150(2) 476-484.

- Grewal, K., Sandhu, G., Kaur, R., Brar, R., Sandhu, H., 2010. Toxic impacts of cypermethrin on behavior and histology of certain tissues of albino rats. *Toxicol Int.* 17, 94.
- Guillen-Jimenez, F.d.M., Cristiani-Urbina, E., Cancino-Diaz, J.C., Flores-Moreno, J.L., Barragan-Huerta, B.E., 2012. Lindane biodegradation by the *Fusarium verticillioides* AT-100 strain, isolated from Agave tequilana leaves: kinetic study and identification of metabolites. *Inter Biodeter.Biodegr.* 74, 36-47.
- Gundi, V.A., Reddy, B., 2006. Degradation of monocrotophos in soils. *Chemosphere* 62, 396-403.
- Gupta, M., Mathur, S., Sharma, T.K., Rana, M., Gairola, A., Navani, N.K., Pathania, R., 2016. A study on metabolic prowess of *Pseudomonas* sp. RPT 52 to degrade imidacloprid, endosulfan and coragen. *J Hazard Mater.* 301, 250-258.
- Gupta, S., Gajbhiye, V.T., 2002. Effect of concentration, moisture and soil type on the dissipation of flufenacet from soil. *Chemosphere.* 47, 901-906.
- Haldane, J.S.B., *Enzymes*. Longmans, Green, UK (Republished by MIT Press, Cambridge, MA1965). 1930.
- Hamscher, G., Sczesny, S., Hoper, H., Nau, H., 2002. Determination of persistent tetracycline residues in soil fertilized with liquid manure by high-performance liquid chromatography with electrospray ionization tandem mass spectrometry. *Anal. Chem.* 74 (7), 1509-1518.
- Hanhan, O., Insel, G., Yagci, N.O., Artan, N., Orhon, D., 2011. Mechanism and design of intermittent aeration activated sludge process for nitrogen removal. *J Environ Sci Health, A.* 46 (1), 9-16.
- Helbling, D.E., 2015. Bioremediation of pesticide-contaminated water resources: the challenge of low concentrations. *Curr Opin Biotechnol.* 33, 142-148.
- Hofmann, K., Bucher, P., Falquet, L., Bairoch, A., 1999, The PROSITE database, its status in 1999. *Nucleic Acids Res.* 27, 215-219
- Huang J., Nemati M., Hill G., Headley J., 2012. Batch and continuous biodegradation of three model naphthenic acids in a circulating packed-bed bioreactor. *J. Hazard Mater.* 201, 132-140.
- Huang, B. 2009. MetaPocket: a meta approach to improve protein ligand binding site prediction. *OMICS.* 13, 325-330.

- Hussaini, S.Z., Shaker, M., Iqbal, M.A., 2013. Isolation of bacterial for degradation of selected pesticides. *Adv Biores* 4, 82-85.
- Imhoff, M.L., Bounoua, L., DeFries, R., Lawrence, W.T., Stutzer, D., Tucker, C.J., Ricketts, T., 2004. The consequences of urban land transformation on net primary productivity in the United States. *Remote Sens.* 89, 434-443.
- International Agency For Research on Cancer (IARC), evaluation of five organophosphate insecticides and herbicides (WHO), 2015. 20 March, Monographs 112 (2015).
- Janeczko, A.K., Walters, E.B., Schuldt, S.J., Magnuson, M.L., Willison, S.A., Brown, L.M., Ruiz, O.N., Felker, D.L., Racz, L., 2014. Fate of malathion and a phosphonic acid in activated sludge with varying solids retention times. *Water Research*, 57, 127-139.
- Jardim, A.N., Caldas, E.D., 2012. Brazilian monitoring programs for pesticide residues in food—Results from 2001 to 2010. *Food Control.* 25, 607-616.
- Jess, S., Kildea, S., Moody, A., Rennick, G., Murchie, A.K., Cooke, L.R., 2014. European Union policy on pesticides: implications for agriculture in Ireland. *Pest Manag Sci.* 70, 1646-1654.
- Jones, W.J., Ananyeva, N.D., 2001. Correlations between pesticide transformation rate and microbial respiration activity in soil of different ecosystems. *Biol. Fertil. Soils.*33, 477-483.
- Jorgensen, K.S., 2007. In situ bioremediation. *Adv Appl Microbiol.*61, 285-305.
- Joseph J.M., Destailats H., Hung H.M., Hoffmann M.R., 2000. The sonochemical degradation of azobenzene and related azo dyes: rate enhancements via Fenton's reactions. *J. Phys. Chem. A* 104, 301-307.
- Ju, X.T., Kou, C.L., Christie, P., Dou, Z., Zhang, F., 2007. Changes in the soil environment from excessive application of fertilizers and manures to two contrasting intensive cropping systems on the North China Plain. *Environ Pollut.*145, 497-506.
- Kalevitch, M.V., Kefeli, V.I., 2007. Study of bacterial activity in fabricated soils. *Int J Environ Pollut.*29, 412-423.
- Kang Y.W., Cho M.J., Hwang K.Y., 1999. Correction of hydrogen peroxide interference on standard chemical oxygen demand test, *Water Research*, 33(5) 1247.
- Karpouzas, D.G., Singh, B.K., 2006. Microbial degradation of organophosphorus xenobiotics: metabolic pathways and molecular basis. *Adv. Microb. Physiol.* 51, 119-225.

- Kaufman, B.A., 2004. Studies on mitochondrial DNA nucleoids in *Saccharomyces cerevisiae*: Identification of bifunctional proteins.
- Kavitha V., Palanivelu K., 2005. Destruction of cresols by Fenton oxidation process. *Water Resource*. 39, 3062-3072.
- Kavitha, P., Rao, J.V., 2007. Oxidative stress and locomotor behaviour response as biomarkers for assessing recovery status of mosquito fish, *Gambusia affinis* after lethal effect of an organophosphate pesticide, monocrotophos. *Pestic Biochem Physiol*.87, 182-188.
- Khan, E., Huang, C., Reed, B.E., 2005. Hazardous waste treatment technologies (JSTOR).
- Khan, S., Zaffar, H., Irshad, U., Ahmad, R., Khan, A.R., Shah, M.M., Bilal, M., Iqbal, M., Naqvi, T., 2016. Biodegradation of Malathion By *Bacillus licheniformis* strain MI-1. 68,51-59.
- Kim, Y.H., Ahn, J.Y., Moon, S.H., Lee, J., 2005. Biodegradation and detoxification of organophosphate insecticide, malathion by *Fusarium oxysporum* f. sp. pisi cutinase. *Chemosphere*, 60 (10), 1349-1355.
- Kmellar, B., Fodor, P., Pareja, L., Ferrer, C., Martinez-Uroz, M., Valverde, A., Fernandez-Alba, A., 2008. Validation and uncertainty study of a comprehensive list of 160 pesticide residues in multi-class vegetables by liquid chromatography-tandem mass spectrometry. *J. Chromatogr. A*.1215, 37-50.
- Kong, L., Zhu, S., Zhu, L., Xie, H., Su, K., Yan, T., Wang, J., Wang, J., Wang, F., Sun, F., 2013. Biodegradation of organochlorine pesticide endosulfan by bacterial strain *Alcaligenes faecalis* JBW4. *J Environ Sci*.25, 2257-2264.
- Konrad, J.G., Chesters, G., Armstrong, D.E., 1969. Soil degradation of malathion, a phosphorodithioate insecticide. *Soil Sci Soc Am J*. 33 (2), 259-262.
- Krieger, E., Darden, T., Nabuurs, S.B., Finkelstein, A., Vriend, G., 2004, Making optimal use of empirical energy functions: force-field parameterization in crystal space. *Proteins: Struct., Funct., Bioinf*. 57, 678-683.
- Krzywinski M, Schein J, Birol I, Connors J, Gascoyne R, Horsman D, Jones S. J, Marra M.A. 2009, Circos: an information aesthetic for comparative genomics. *Genome Res*. 19, 1639-45.

- Kumar, A., Dhall, P., Kumar, R., 2010. Redefining BOD: COD ratio of pulp mill industrial wastewaters in BOD analysis by formulating a specific microbial seed. *Inter Biodeter.Biodegr.* 64 (3), 197-202
- Kumar, M., Philip, L., 2006. Enrichment and isolation of a mixed bacterial culture for complete mineralization of endosulfan. *J Environ Sci Health B.* 41, 81-96.
- Kureel M.K., Geed S.R., Giri B.S., Shukla A.K., Rai B.N., Singh R.S., 2016. Removal of aqueous benzene in the immobilized batch and continuous packed bed bioreactor by isolated *Bacillus* sp. M1. *Resour Eff Technol.* 2, S87-95.
- Kureel, M.K., Geed, S.R., Giri, B.S., Rai, B.N., Singh, R.S., 2017. Biodegradation and kinetic study of benzene in bioreactor packed with PUF and alginate beads and immobilized with *Bacillus* sp. M3. *Bioresour Technol.*, 242, 92-100.
- Lakshmi, C.V., Kumar, M., Khanna, S., 2008. Biotransformation of chlorpyrifos and bioremediation of contaminated soil. *Inter Biodeter.Biodegr.* 62, 204-209.
- Lee, M.H., Scherer, M., Rigali, S., Golden, J.W., 2003. Plm A, a new member of the GntR family, has plasmid maintenance functions in *Anabaena* sp. strain PCC 7120. *J. Bacteriol.* 185, 4315-4325.
- Lewis, W.H., Elvin-Lewis, M.P., 2003. *Medical botany: plants affecting human health* (John Wiley & Sons).
- Li, X., Xu, K., Fu, W., Wang, J., Zhu, Y., Li, C., Zhou, X., 2014. Simultaneous in-situ excess sludge reduction and removal of organic carbon and nitrogen by a pilot-scale continuous aerobic-anaerobic coupled (CAAC) process for deeply treatment of soybean wastewater. *Biochem Eng J.* 85, 30-37.
- Lim, J.X., Vadivelu, V.M., 2014. Treatment of agro based industrial wastewater in sequencing batch reactor: Performance evaluation and growth kinetics of aerobic biomass. *J. Environ Manag.* 146, 217-225.
- Lima, D., Viana, P., Andre, S., Chelinho, S., Costa, C., Ribeiro, R., Sousa, J.P., Fialho, A.M., Viegas, C.A., 2009. Evaluating a bioremediation tool for atrazine contaminated soils in open soil microcosms: the effectiveness of bioaugmentation and biostimulation approaches. *Chemosphere.* 74, 187-192.
- Liu, D., Wang, P., Zhu, W., Gu, X., Zhou, W., Zhou, Z., 2008. Enantioselective degradation of fipronil in Chinese cabbage (*Brassica pekinensis*). *Food Chem.* 110, 399-405.

- Liu, F. Y. Hong, M.Z., Liu, D.M., LI, Y.W., Shou, P.S., Hai, Y.A.N., Shi, G.Q., 2007. Biodegradation of methyl parathion by *Acinetobacter radioresistens* USTB-04. *J Environ Sci.*, 19 (10), 1257-1260
- Liu, J., Tan, L., Wang, J., Wang, Z., Ni, H., Li, L., 2016. Complete biodegradation of chlorpyrifos by engineered *Pseudomonas putida* cells expressing surface-immobilized laccases. *Chemosphere.* 157, 200-207.
- Liu, Y., Kang, X., Li, X., Yuan, Y., 2015. Performance of aerobic granular sludge in a sequencing batch bioreactor for slaughter house wastewater treatment. *Bioresour Technol.* 190, 487-491.
- Longnecker, M.P., Rogan, W.J., Lucier, G., 1997. The human health effects of DDT (dichlorodiphenyltrichloroethane) and PCBs (polychlorinated biphenyls) and an overview of organochlorines in public health 1. *Annu Rev Public Health.* 18, 211-244.
- Lovell, S.C., Davis, I.W., Arendall, W.B., de Bakker, P.I., Word, J.M., Prisant, M.G., Richardson, J.S., Richardson, D.C. 2003. Structure validation by C α geometry: ϕ , ψ and C β deviation. *Proteins: Struct., Funct., Bioinf.* 50, 437-450.
- Mandal, A. and Singh, N., 2017. Optimization of atrazine and imidacloprid removal from water using biochars: Designing single or multi-staged batch adsorption systems. *Int J Hyg Environ Health.* 220(3), 637-645.
- Mandal, K., Singh, B., Jariyal, M., Gupta, V., 2013. Microbial degradation of fipronil by *Bacillus thuringiensis*. *Ecotoxicol Environ Saf.* 93, 87-92.
- Mandal, K., Singh, B., Jariyal, M., Gupta, V., 2014. Bioremediation of fipronil by a *Bacillus firmus* isolate from soil. *Chemosphere.* 101, 55-60.
- Manolov, I., 2014. Lecture 5: Soil fertility and organic fertilizers in organic farming (Agricultural University of Tirana).
- Mansour, M., Feicht, E., 1994. Transformation of chemical contaminants by biotic and abiotic processes in water and soil. *Chemosphere.* 28, 323-332.
- Martin, M., Perez, J., Fernandez, F., Sanchez, J., Lopez, J., Rodriguez, S., 2008. Kinetic study on the biodegradation of sythetic wastewater simulating effluent from an advanced oxidation process using *Pseudomonas putida* CECT 324. *J. Hazard Mater.* 151, 780-788

- Masaphy, S., Levanon, D., Henis, Y., 1996. Degradation of atrazine by the lignocellulolytic fungus *Pleurotus pulmonarius* during solid-state fermentation. *Bioresour. Technol.* 56, 207-214.
- Mcdaniel, K.L., Moser, V.C., 1993. Utility of a neurobehavioral screening battery for differentiating the effects of two pyrethroids, permethrin and cypermethrin. *Neurotoxicol. Teratol.* 15, 71-83.
- Mohamed, Z.K., Ahmed, M.A., Fetyan, N.A., Elnagdy, S.M., 2010. Isolation and molecular characterisation of malathion-degrading bacterial strains from waste water in Egypt. *Int.J. Adv. Res.*1, 145-149.
- Mohan SV, Shailaja S, Krishna M.R., Reddy K.B., Sarma P.N., 2006. Bioslurry phase degradation of diethyl phthalate (DEP) contaminated soil in periodic discontinuous mode operation: Influence of bioaugmentation and substrate partition. *Process Biochem.* 41, 3644
- Monkiedje, A., Spiteller, M., Bester, K., 2003. Degradation of racemic and enantiopure metalaxyl in tropical and temperate soils. *Environ. Sci. Technol.* 37(4), 707-712.
- Monod, J., 1949. The growth of bacterial cultures. *Ann. Rev. Microbiol.* 3, 371-376.
- Mougin, C., Laugero, C., Asther, M., Dubroca, J., Frasse, P., Asther, M., 1994. Biotransformation of the herbicide atrazine by the white rot fungus *Phanerochaete chrysosporium*. *Appl Environ Microbiol.* 60, 705-708.
- Moussavi, G. and Ghorbanian, M., 2015. The biodegradation of petroleum hydrocarbons in an upflow sludge-blanket/fixed-film hybrid bioreactor under nitrate-reducing conditions: Performance evaluation and microbial identification. *Chem Eng J.* 280, 121-131.
- Neoh, C.H., Noor, Z.Z., Mutamim, N.S.A., Lim, C.K., 2016. Green technology in wastewater treatment technologies: integration of membrane bioreactor with various wastewater treatment systems. *Chem. Eng. J.* 283, 582-594.
- Ngowi, A., Mbise, T., Ijani, A., London, L., Ajayi, O., 2007. Smallholder vegetable farmers in Northern Tanzania: Pesticides use practices, perceptions, cost and health effects. *Crop Prot.* 26, 1617-1624.
- Oerke, E.-C., Dehne, H. W., 2004. Safeguarding production—losses in major crops and the role of crop protection. *Crop Prot.* 23, 275-285.

References

- Ohi, M., Dalsenter, P., Andrade, A., Nascimento, A., 2004. Reproductive adverse effects of fipronil in Wistar rats. *Toxicol. Lett.* 146, 121-127.
- Ormad, M., Miguel, N., Claver, A., Matesanz, J., Ovelleiro, J., 2008. Pesticides removal in the process of drinking water production. *Chemosphere.* 71, 97-106.
- Othman, I., Anuar, A.N., Ujang, Z., Rosman, N.H., Harun, H., Chelliapan, S., 2013. Livestock wastewater treatment using aerobic granular sludge. *Bioresour Technol.* 133, 630-634.
- Pabo, C.O. and Lewis, M. The operator-binding domain of lambda repressor: structure and DNA recognition. *Nature.* 1982. 298,443.
- Pal, R., Chakrabarti, K., Chakraborty, A., Chowdhury, A., 2006. Degradation and effects of pesticides on soil microbiological parameters-A review 1 (3) 240-258.
- Park, D., Lee, D.S., Kim, Y.M., Park, J.M., 2008. Bioaugmentation of cyanide-degrading microorganisms in a full-scale cokes wastewater treatment facility. *Bioresour. Technol.* 99, 2092-2096.
- Paszczynski, A., Crawford, R.L., 1995. Potential for bioremediation of xenobiotic compounds by the white-rot fungus *Phanerochaete chrysosporium*. *Biotechnol. Progr.* 11, 368-379.
- Peer, D., Karp, J.M., Hong, S., Farokhzad, O.C., Margalit, R., Langer, R., 2007. Nanocarriers as an emerging platform for cancer therapy. *Nat. Nanotechnol.* 2, 751-760.
- Perelo, L.W., 2010. Review: in situ and bioremediation of organic pollutants in aquatic sediments. *J Hazard Mater.* 177, 81-89.
- Pett-Ridge, J., Firestone, M.K., 2005. Redox fluctuation structures microbial communities in a wet tropical soil. *Appl Environ Microbiol.* 71, 6998-7007
- Pimentel, D., 2005. Environmental and economic costs of the application of pesticides primarily in the United States. *Environ Dev Sustain.* 7, 229-252.
- Plakas, K.V., Karabelas, A.J., 2012. Removal of pesticides from water by NF and RO membranes-A review. *Desalination* 287, 255-265.
- Plangklang, P., Reungsang, A., 2009. Bioaugmentation of carbofuran residues in soil using *Burkholderia cepacia* PCL3 adsorbed on agricultural residues. *Inter Biodeter.Biodegr.* 63, 515-522.

- Plangklang, P., Reungsang, A., 2010. Bioaugmentation of carbofuran by *Burkholderia cepacia* PCL3 in a bioslurry phase sequencing batch reactor. *Process Biochem.* 45, 230-238.
- Plangklang, P., Reungsang, A., 2011. Bioaugmentation of carbofuran residues in soil by *Burkholderia cepacia* PCL3: a small-scale field study. *Inter Biodeter.Biodegr.*65, 902-905.
- Pointing, S., 2001. Feasibility of bioremediation by white-rot fungi. *Appl. Microbiol. Biotechnol.* 57, 20-33.
- Popp, J., Peto, K., Nagy, J., 2013. Pesticide productivity and food security. A review. *Agron. Sustain. Dev.*, 33(1),243-255.
- Porto, A.L.M., Melgar, G.Z., Kasemodel, M.C., Nitschke, M., 2011. Biodegradation of pesticides. In *Pesticides in the Modern World-Pesticides Use and Management*. InTech.
- Purnomo, A.S., Mori, T., Takagi, K., Kondo, R., 2011. Bioremediation of DDT contaminated soil using brown-rot fungi. *Inter Biodeter.Biodegr.*65, 691-695.
- Qingyan, L., Ying, L., Xikun, Z., Baoli, C., 2008. Isolation and characterization of atrazine-degrading *Arthrobacter* sp. AD26 and use of this strain in bioremediation of contaminated soil. *J. Environ. Sci.* 20, 1226-1230.
- Qu, J., Xu, Y., Ai, G.-M., Liu, Y., Liu, Z.-P., 2015. Novel *Chryseobacterium* sp. PYR2 degrades various organochlorine pesticides (OCPs) and achieves enhancing removal and complete degradation of DDT in highly contaminated soil. *J. Environ. Manage.* 161, 350-357.
- Rabotnova, I.L., Schwartz, W., 1962. The importance of physical chemical factors (pH and rH₂) for the life activity of microorganisms. VEB Gustav Fischer Verlag, Berlin
- Racke, K., Skidmore, M., Hamilton, D., Unsworth, J., Miyamoto, J., Cohen, S., 1999. Pesticide fate in tropical soils. *Pesticide Science* 55, 219-220.
- Rafferty, J.B., Sedelnikova, S.E., Hargreaves, D. and Artymiuk, P.J. 1996. Crystal structure of DNA recombination protein RuvA and a model for its binding to the Holliday junction. *Science.* 274, 415-421.
- Ramsay, M.A., Swannell, R.P., Shipton, W.A., Duke, N.C., Hill, R.T., 2000. Effect of bioremediation on the microbial community in oiled mangrove sediments. *Mar. Pollut. Bull.* 41, 413-419.

- Rao, R.P., Kaliwal, B.B., 2002. Monocrotophos induced dysfunction on estrous cycle and follicular development in mice. *Industrial health* 40, 237-244.
- Reddy, C.A., Mathew, Z., 2001. Bioremediation potential of white rot fungi. Paper presented at: British Mycological Society Symposium Series.
- Rene, E.R., Murthy, D.V.S., Swaminathan, T., 2005. Performance evaluation of a compost biofilter treating toluene vapours. *Process Biochem.* 40, 2771-2779.
- Renwick, A.G., 2002. Pesticide residue analysis and its relationship to hazard characterisation (ADI/ARfD) and intake estimations (NEDI/NESTI). *Pest Manag Sci.* 58, 1073-1082.
- Richardson, R.E., James, C.A., Bhupathiraju, V.K., Alvarez-Cohen, L., 2002. Microbial activity in soils following steam treatment. *Biodegradation.* 13, 285-295.
- Rigas, F., Dritsa, V., Marchant, R., Papadopoulou, K., Avramides, E., Hatzianestis, I., 2005. Biodegradation of lindane by *Pleurotus ostreatus* via central composite design. *Environ. Int.* 31, 191-196.
- Robinson, R.A., Sutherland, W.J., 2002. Post war changes in arable farming and biodiversity in Great Britain. *J. Appl. Ecol.* 39, 157-176.
- Robles-Gonzalez, I.V., Fava, F., Poggi-Varaldo, H.M., 2008. A review on slurry bioreactors for bioremediation of soils and sediments. *Microb Cell Fact* 7 (1) 5.
- Rodrigues, G.N., Alvarenga, N., Vacondio, B., de Vasconcellos, S.P., Passarini, M.R., Selegim, M.H., Porto, A.L., 2016. Biotransformation of methyl parathion by marine-derived fungi isolated from ascidian *Didemnum ligulum*. *Biocatal Agric Biotechnol.* 7, 24-30.
- Russell, J.B., Dombrowski, D.B., 1980. Effect of pH on the efficiency of growth by pure cultures of rumen bacteria in continuous culture. *Appl Environ Microbiol.* 39(3), 604-610.
- Saez, J.M., Aparicio, J.D., Amoroso, M.J., Benimeli, C.S., 2015. Effect of the acclimation of a *Streptomyces* consortium on lindane biodegradation by free and immobilized cells. *Process Biochem.* 50, 1923-1933.
- Saiyed, H., Dewan, A., Bhatnagar, V., Shenoy, U., Shenoy, R., Rajmohan, H., Patel, K., Kashyap, R., Kulkarni, P., Rajan, B., 2003. Effect of Endosulfan on male reproductive development. *Environ. Health Perspect.* 111, 1958.

- Sambrook, J., Russell, D.W., 2001. *Molecular Cloning a Laboratory Manual*. Coldspning-Harbour Laboratory Press, UK.
- Sanchis S., Polo A. M., Tobajas M., Rodriguez J. J. & Mohedano A. F., 2014. Coupling Fenton and biological oxidation for the removal of nitrochlorinated herbicides from water. *Water Res*, 49, 197-206.
- Santhakumar, M., Balaji, M., Ramudu, K., 1999. Effect of sublethal concentrations of monocrotophos on erythropoietic activity and certain hematological parameters of fish *Anabas testudineus* (Bloch). *Bull Environ Contam Toxicol*. 63, 379-384.
- Sari, A.A., Tachibana, S., Itoh, K., 2012. Determination of co-metabolism for 1, 1, 1-trichloro-2, 2-bis (4-chlorophenyl) ethane (DDT) degradation with enzymes from *Trametes versicolor* U97. *J. Biosci. Bioeng*. 114, 176-181.
- Seech, A., Bolanos - Shaw, K., Hill, D., Molin, J., 2008. In situ bioremediation of pesticides in soil and groundwater. *Remed J*. 19 (1) 87-98.
- Seeger, E.M., Kusch, P., Fazekas, H., Grathwohl, P., Kaestner, M., 2011. Bioremediation of benzene-, MTBE-and ammonia-contaminated groundwater with pilot-scale constructed wetlands. *Environ. Pollut*. 159, 3769-3776.
- Shahi, A., Rai, B.N., Singh, R.S. Analysis of Metabolites and Carbon Balance in the Biofiltration of Cumene Using Loofa Sponge as Biofilter Media. *Appl Biochem Biotechnol*. 2016, 1-11.
- Sharpe, R.M. and Irvine, D.S., 2004. How strong is the evidence of a link between environmental chemicals and adverse effects on human reproductive health?. *BMJ*, 328 (7437),447.
- Shevchenko, A., Tomas, H., Havli, J., Olsen, J.V., Mann, M. 2006. In-gel digestion for mass spectrometric characterization of proteins and proteomes. *Nature protocols*. 1, 2856-2860.
- Shukla AK., Vishwakarma P., Upadhyay S.N., Tripathi A.K., Prasanna H.C., Dubey S.K. 2009. Biodegradation of trichloroethylene (TCE) by methanotrophic community. *Bioresour Technol*. 100, 2469-2474.
- Shukla, A.K., Singh, R.S., Upadhyay, S.N., Dubey, S.K., 2010. Kinetics of bio-filtration of trichloroethylene by methanotrophs in presence of methanol. *Bioresour Technol*. 101 (21), 8119-8126.

- Siddique, T., Okeke, B.C., Arshad, M., Frankenberger, W.T., 2003. Enrichment and isolation of endosulfan-degrading microorganisms. *J. Environ. Qual.* 32, 47-54.
- Sikdar, S.K., Grosse, D., Rogut, I., 1998. Membrane technologies for remediating contaminated soils: a critical review. *J. Membr. Sci.* 151, 75-85.
- Singh B.K., Walker A., Morgan J.A.W., Wright D.J. 2003, Effects of soil pH on the biodegradation of chlorpyrifos and isolation of a chlorpyrifos-degrading bacterium. *Appl. Environ. Microbiol.* 69 (9) 5198-5206.
- Singh, B., Kaur, J., Singh, K., 2012. Biodegradation of malathion by *Brevibacillus* sp. strain KB2 and *Bacillus cereus* strain PU. *World J. Microbiol. Biotechnol.* 28, 1133-1141.
- Singh, B., Kaur, J., Singh, K., 2012. Transformation of malathion by *Lysinibacillus* sp. isolated from soil. *Biotechnol Lett.* 34 (5), 863-867.
- Singh, B.K., Walker, A., Wright, D.J., 2006a. Bioremedial potential of fenamiphos and chlorpyrifos degrading isolates: influence of different environmental conditions. *Soil Biol. Biochem.* 38, 2682-2693.
- Singh, P., Saini, H.S., Raj, M., 2016. Rhamnolipid mediated enhanced degradation of chlorpyrifos by bacterial consortium in soil-water system. *Ecotoxicol Environ Saf.* 134, 156-162.
- Singh, P.K., Shrivastava, A.K., Chatterjee, A., Pandey, S., Rai, S., Singh, S., Rai, L.C. 2015. Cadmium toxicity in diazotrophic *Anabaena* sp. adjudged by hasty up-accumulation of transporter and signaling and severe down-accumulation of nitrogen metabolism proteins. *J. Proteom.* 127, 134-146.
- Singh, R., Jhorar, R., Van Dam, J., Feddes, R., 2006b. Distributed ecohydrological modelling to evaluate irrigation system performance in Sirsa district, India II: Impact of viable water management scenarios. *J Hydrol.* 329, 714-723.
- Singh, R.S., Rai, B.N., Upadhyay, S.N., 2010. Removal of toluene vapour from air stream using a biofilter packed with polyurethane foam. *Process Saf Environ Prot.* 88 (5) 366-371.
- Song, Y.Y., Xiao, L., Ren, F.S., 2011. Variability of pesticide residues in vegetables from the marketplaces in Jinan city. *Agric. Sci. China.* 10, 1646-1652.

- Soto, A.M., Chung, K.L., Sonnenschein, C., 1994. The pesticides endosulfan, toxaphene, and dieldrin have estrogenic effects on human estrogen-sensitive cells. *Environ. Health Perspect.* 102 (4), 380.
- Srivastva, N., Singh, R.S., Upadhyay, S.N., Dubey, S.K., 2016. Degradation kinetics and metabolites in continuous biodegradation of isoprene. *Bioresour Technol*, 206, 275-278.
- Stackebrandt, E., Liesack, W., Goebel, B.M. 1993. Bacterial diversity in a soil sample from a subtropical Australian environment as determined by 16S rDNA analysis. *FASEB J.* 7, 232–236.
- Stelting, S.A., Burns, R.G., Sunna, A., Bunt, C.R., 2014. Survival in sterile soil and atrazine degradation of *Pseudomonas* sp. strain ADP immobilized on zeolite. *Biorem. J.* 18, 309-316.
- Sujatha, R., Chitra, K., Latchoumycandane, C., Mathur, P., 2001. Effect of lindane on testicular antioxidant system and steroidogenic enzymes in adult rats. *Asian J Androl.* 3, 135-138.
- Szulejko, J.E., Kumar, P., Deep, A., Kim, K. H., 2017. Global warming projections to 2100 using simple CO₂ greenhouse gas modeling and comments on CO₂ climate sensitivity factor. *Atmos Pollut Res.* 8, 136-140.
- Tan, H., Cao, Y., Tang, T., Qian, K., Chen, W.L., Li, J., 2008. Biodegradation and chiral stability of fipronil in aerobic and flooded paddy soils. *Sci. Total Environ.* 407.437-428 ,
- Tang, M., You, M., 2012. Isolation, identification and characterization of a novel triazophos-degrading *Bacillus* sp. (TAP-1). *Microbiol Res.* 167(5), 299-305
- Tazdait, D., Abdi, N., Grib, H., Lounici, H., Pauss, A., Mameri, N., 2014. Comparison of different models of substrate inhibition in aerobic batch biodegradation of malathion. *Turk. J. Eng. Environ. Sci.*, 37 (3), 221-230.
- Tazdaït, D., Abdi, N., Lounici, H., Grib, H., Mameri, N., Pauss, A., 2013. Biodegradation of malathion with indigenous acclimated activated sludge in batch mode and in continuous-flow packed-bed reactor. *Bioremediat. J.* 17 (4), 294-304.
- Thangadurai, P., Suresh, S., 2014. Biodegradation of endosulfan by soil bacterial cultures. *Inter Biodeter Biodegr.* 94, 38-47.

References

- Thomas L., Sindhu R., Binod P., Pandey A., 2015. Production of cellulose free alkaline xylanase from *Bacillus* MTCC 5015 by submerged fermentation and its application in bio-bleaching. *Indian Indian J Exp Biol*, 53, 356-363.
- Thompson, J.D., Gibson, T.J., Plewniak, F., Jeanmougin, F., Higgins D.G., 1997. The CLUSTAL_X windows interface: flexible strategies for multiple sequence alignment aided by quality analysis tools. *Nucleic Acids Res.* 25, 4876-4882.
- Tingle, C., Rother, J., Dewhurst, C., Lauer, S., King, W., 2000. Health and environmental effects of fipronil. Briefing paper for Pesticides Action Network, UK.
- Tingle, C.C., Rother, J.A., Dewhurst, C.F., Lauer, S., King, W.J., 2003. Fipronil: environmental fate, ecotoxicology, and human health concerns. *Rev Environ Contam Toxicol.* 1-66.
- Tomei, L., Altamura, S., Bartholomew, L., Bisbocci, M., Bailey, C., Bosserman, M., Cellucci, A., Forte, E., Incitti, I., Orsatti, L., Koch, U., 2004. Characterization of the inhibition of hepatitis C virus RNA replication by nonnucleosides. *J Virol* 78(2), 938-946.
- Topp, E., Vallaey, T., Soulas, G., 1997. Pesticides: microbial degradation and effects on microorganisms. *Modern Soil Microbiol*, 547-575.
- Trindade, P., Sobral, L., Rizzo, A., Leite, S., Soriano, A., 2005. Bioremediation of a weathered and a recently oil-contaminated soils from Brazil: a comparison study. *Chemosphere.* 58, 515-522.
- Uzunhisarcikli, M., Kalender, Y., Dirican, K., Kalender, S., Ogutcu, A., Buyukkomurcu, F., 2007. Acute, subacute and subchronic administration of methyl parathion-induced testicular damage in male rats and protective role of vitamins C and E. *Pestic. Biochem. Physiol.* 87, 115-122.
- Van Aken, B., Hofrichter, M., Scheibner, K., Hatakka, A.I., Naveau, H., Agathos, S.N., 1999. Transformation and mineralization of 2, 4, 6-trinitrotoluene (TNT) by manganese peroxidase from the white-rot basidiomycete *Phlebia radiata*. *Biodegradation.* 10, 83-91.
- Van-Aalten, D.M.F., Di Russo, C.C., Knudsen, J., Wierenga, R.K. Crystal structure of FadR, a fatty acid-responsive transcription factor with a novel acyl coenzyme A-binding fold. *EMBO J.* 2000, 19, 5167-5177.

- Vargha M, Takats, Z., Marialigeti K, 2005. Degradation of atrazine in a laboratory scale model system with Danube river sediment. *Water Res*, 39(8) 1560.
- Verdin, A., Sahraoui, A.L.-H., Durand, R., 2004. Degradation of benzo pyrene by mitosporic fungi and extracellular oxidative enzymes. *Inter Biodeter. Biodegr.* 53, 65-70.
- Verma, M., Brar, S.K., Tyagi, R., Surampalli, R., 2007. Bioremediation with fungi. Paper presented at: Remediation Technologies for Soils and Groundwater (ASCE).
- Vetting, M.W., Frantom, P.A. Blanchard, J.S., Structural and Enzymatic Analysis of Msh A from *Corynebacterium glutamicum* substrate-assisted catalysis. *J. Biol. Chem.* 2008, 283, 15834-15844.
- Vidali, M., 2001. Bioremediation. an overview. *Pure Appl. Chem.* 73, 1163-1172.
- Vyas, V.K., Ukawala, R.D., Ghate, M., Chintha, C., 2012, Homology modeling a fast tool for drug discovery: current perspectives. *Indian J. Pharm. Sci* 74 (1) 1.
- Wagschal, K., Franqui-Espiet, D., Lee, C.C., Kibblewhite-Accinelli, R.E., Robertson, G.H., Wong, D.W., 2007. Genetic and biochemical characterization of an α -L-arabinofuranosidase isolated from a compost starter mixture. *Enzyme Microb. Technol.* 40, 747-753.
- Wang, H.Z., Zuo, H.G., Ding, Y.J., Miao, S.S., Jiang, C., Yang, H., 2014a. Biotic and abiotic degradation of pesticide Dufulin in soils. *Environ. Sci. Pollut. Res.* 21, 4331-4342.
- Wang, L., Chi, X.Q., Zhang, J.J., Sun, D.L. and Zhou, N.Y., 2014b. Bioaugmentation of a methyl parathion contaminated soil with *Pseudomonas* sp. strain WBC-3. *Inter Biodeter. Biodegr.* 87, 116-121.
- Wang, Q., Xie, S., Hu, R., 2013. Bioaugmentation with *Arthrobacter* sp. strain DAT1 for remediation of heavily atrazine-contaminated soil. *Inter Biodeter Biodegr.* 77, 63-67.
- Watson, S.L., 2014. Assessing the Impacts of Unrestricted Pesticide Use in Small-Scale Agriculture on Water Quality and Associated Human Health and Ecological Implications in an Indigenous Village in Rural Panam [aacute].
- Xu, G., Zheng, W., Li, Y., Wang, S., Zhang, J., Yan, Y., 2008. Biodegradation of chlorpyrifos and 3, 5, 6-trichloro-2-pyridinol by a newly isolated *Paracoccus* sp. strain TRP. *Inter Biodeter Biodegr.* 62, 51-56.
- Yadav, I.C., Devi, N.L., Syed, J.H., Cheng, Z., Li, J., Zhang, G., Jones, K.C., 2015. Current status of persistent organic pesticides residues in air, water, and soil, and their possible

- effect on neighboring countries: a comprehensive review of India. *Sci Total Environ*, 511, 123-137.
- Yadav, M., Srivastva, N., Singh, R.S., Upadhyay, S.N., Dubey, S.K., 2014. Biodegradation of chlorpyrifos by *Pseudomonas* sp. in a continuous packed bed bioreactor. *Bioresour. Technol.* 165, 265-269.
- Yang, L., Chen, S., Hu, M., Hao, W., Geng, P., Zhang, Y., 2011. Biodegradation of carbofuran by *Pichia anomala* strain HQ-C-01 and its application for bioremediation of contaminated soils. *Biology and Fertility of Soils.* 47, 917.
- Yang, L., Zhao, Y.H., Zhang, B.X., Yang, C.H., Zhang, X., 2005. Isolation and characterization of a chlorpyrifos and 3, 5, 6-trichloro-2-pyridinol degrading bacterium. *FEMS Microbiol Lett.* 251,67-73.
- Yoshida, K.I., Fujita, Y., Ehrlich, S.D., 1999. Three Asparagine Synthetase Genes of *Bacillus subtilis*. *J. Bacteriol.* 181, 6081-6091.
- Yousef, M., El Demerdash, F., Al Salhen, K., 2003. Protective role of isoflavones against the toxic effect of cypermethrin on semen quality and testosterone levels of rabbits. *J. Environ. Sci. Health., Part B.*38, 463-478.
- Zhang C., Li M., Xu X., Liu N., 2015. Effects of carbon nanotubes on atrazine biodegradation by *Arthrobacter* sp. *J Hazard Mater.* 287 1-6.
- Zhang, B., Ji, M., Qiu, Z., Liu, H., Wang, J., Li, J., 2011. Microbial population dynamics during sludge granulation in an anaerobic–aerobic biological phosphorus removal system. *Bioresour Technol.* 102 (3), 2474-2480.
- Zhao, G., Huang, Q., Rong, X., Cai, P., Liang, W., Dai, K., 2014. Biodegradation of methyl parathion in the presence of goethite: The effect of *Pseudomonas* sp. Z1 adhesion. *Inter Biodeter Biodegr.* 86, 294-299.
- Zhao,X., and Hwang, H.M., 2009. A study of the degradation of organophosphorous pesticide in river water and the identification of their degradation product by chromatography coupled with mass spectroscopy. *Arch. Environ. Contam.Taxicol.* 56, 646-653.

Appendix

Appendix

Data: sequences of isolated bacterial species

| Accession No. | Species Name | sequence |
|---------------|---------------------------|---|
| KX158859 | <i>Bacillus</i> sp. S1 | GGGGCTATAATGCAGTCGAGCGAACTGATTAGAAGCTTGCTTCTATGACGTTAGCGGCGACGGGTGAGTA ACACGTGGGCAACCTGCCTGTAAGACTGGGATAAATTCGGGAAACCAAGCTAATACCGGATAGGATCTTCT CCTTCATGGGAGATGATTGAAAGATGGTTTCGGCTATCACTTACAGATGGGCCCGCGGTGCATTAGCTAGTT GGTGAGGTAACGGCTCACCAAGGCAACGATGCATAGCCGACCTGAGAGGGTGATCGGCCACACTGGGACT GAGACACGGCCAGACTCCTACGGGAGGCAGCAGTAGGGAATCTCCGCAATGGACGAAAGTCTGACGGA GCAACGCCCGGTGAGTGATGAAGGCTTTCGGGTCGTAAAACCTGTTGTTAGGGAAGAACAAGTACGAGAG TAACTGCTCGTACCTTGACGGTACCTAACAGAAAGCCACGGCTAACTACGTGCCAGCAGCCGCGTAATA CGTAGGTGGCAAGCGTTATCCGGAATTTATGGGCGTAAAGCGCGCAGGCGGTTTCTAAGTCTGATGTG AAAGCCACGGCTCAACCGTGGAGGGTCATTGAAAACCTGGGAACTTGAGTGCAGAAGAGAAAAGCGGAA TTCCACGTGTAGCGGTGAAATGCGTAGAGATGTGGAGGAACACCAGTGGCGAAGGCGGCTTTTGGTCTGT AACTGACGCTGAGGCGGAAAGCGTGGGAGCAAAACAGGATTAGATACCCTGGTAGTCCACGCGCTAAAC GATGAGTGCTAAGTGTAGAGGGTTTCCGCCCTTATGCTGCAGCTAACGCATTAAGCACTCCCGCTGGGG AGTACGGTCCGAAGACTGAACTCAAAGGAATTGACGGGGCCCGCACAAAGCGGTGGAGCATGTGGTTTA ATTCGAAGCAACCGGAAGAACCTTACCAGGTCTTGACATCCTTGACAACCTAGAGATAGAGCGTTCCCT TCGGGGACAGAGTGACAGGTGGTGCATGGTTGTCGTCAGCTCGTGTGCTAGGTTAGGGTTAAGTCCCG CAACGAGCGCAACCCCTTGATCTTAGTTGCCAGCATTTAGTTGGGCACTCTAAGGTGACTGCCGGTGACAAAC CGGAGGAAGGTGGGGATGACGTCAAATCATCATGCCCTTATGACCTGGGCTACACACGTTACAAATGGA TGGTACAAAGGGCTGCAAGACCGCGAGGTCAAGCCAATCCATAAAAACCTTCTCAGTTGGATTAGTGGC TGCAACTCGCTACATGAAGCTGGAATCGCTAGTAATCGCGGATCAGCATGCCCGGTGAATACGTTCCCG GGCCTGTACACACCGCCGTCACACCAGAGAGTTTGTAAACCCGAAGTCCGTGGAGTAACCGTAAGGA GCTAACGCTATAAGGTGGCACAGAG |
| KX158860 | <i>Bacillus</i> sp. S2 | AGCCGTGCGGTGCTATAATGCAGTCGAGCGAACTGATTAGAAGCTTGCTTCTATGACGTTAGCGGCGGACGG GTGAGTAACACGTGGGCAACCTGCCTGTAAGACTGGGATAAATTCGGGAAACCGAAGCTAATACCGGATAGG ATCTTCTCCTTCATGGGAGATGATTGAAAGATGGTTTCGGCTATCACTTACAGATGGGCCCGCGGTGCATTAG CTAGTTGGTGAGGTAACGGCTCACCAAGGCAACGATGCATAGCCGACCTGAGAGGGTGATCGGCCACACTGG GACTGAGACACGGCCAGACTCCTACGGGAGCAGCAGTAGGGAATCTCCGCAATAGGAGTCCGCTGAGC GGAGCAACGCCGCGTGAGTGATGAAGGCTTTCGGGTCGTAAAACCTGTTGTTAGGGAAGAACAAGTACGAG AGTAACTGCTCGTACCTTGACGGTACCTAACAGAAAGCCACGGTAACTACGTGCCAGCAGCCGCGTAAT ACGTAGGTGGCAAGCGTTATCCGGAATTTATGGGCGTAAAGCGCGCCGAGGCGGTTTCTTAACTGTAGTGT AAAGCCACGGCTCAACCGTGGAGGGTCATTGAAAACCTGGGAACTTGAGTGCAGAAGAGAAAAGCGGAAT TCCACGTGTAGCGGTGAAATGCGTAGAGATGTGGAGGAACACCAGTGGCGAAGGCGGCTTTTGGTCTGTAA CTGACGCTGAGGCGCGAAAGCGTGGGGAGCAAAACAGGATTAGATACCCTGCTGAGTCCACGCTTAAACGAT GAGTGCTAAGTGTAGAGGGTTTCCGCCCTTATGCTGCAGCTAACGCATTAAGCACTCCGCTGGGGAGTA CGGTCCGAAGACTGAACTCAAAGGAATTGACGGGGCCCGCACAAAGCGGTGGAGCATGTGGTTTAAATCCGA AGCAACCGGAAGAACCTTACCAGGTCTTGACATCCTCTGACAACCTAGAGTACAGCGTTCCTCCGGG GACAGAGTGACAGGTGGTGCATGGTTGTCGTCAGCTCGTGTGAGATGTTGGGTTAAGTCCCGCAACGAG CGCAACCCCTTGATCTTAGTTGCCAGCATTTAGTTGGGCACTCTAAGGTGACTGCCGGTGACAAACCGGAGGA AGGTGGGATGACGTCAAATCATCATGCCCTTATGACCTGGGCTACACAGCTGCTACAATGGATGGTACAA AGGGCTGCAAGACCGCGAGGTCAAGCCAATCCATAAAAACCTTCTCAGTTCGGATTGAGGCTGCAACTCG CCTACATGAAGCTGGAATCGCTAGTAATCGCGGATCAGCATGCCCGGTGAATACGTTCCCGGGCCTGTGAT ACACCGCCGTCACACCAGAGAGTTTGTAAACCCGAAGTCCGTGGAGTAACCGTAAGGAGCTAGCCGCT AAGGTGACAAAATTT |
| KX158862 | <i>Bacillus</i> sp. S4 | GNGGANTNGCGGCTGCTATACATGCAGTCGAGCGAACTGATTAGAAGCTTGCTTCTATGACGTTAGCGGCG GACGGGTGAGTAACACGTGGGCAACCTGCCTGTAAGACTGGGATAAATTCGGGAAACCGAAGCTAATACCG GATAGGATCTTCTCCTTCATGGGAGATGATTGAAAGATGGTTTCGGCTATCACTTACAGATGGGCCCGCGGTG CATTAGCTAGTTGGTGAGGTAACGGCTCACCAAGGCAACGATGCATAGCCGACCTGAGAGGGTGATCGGCCA CACTGGGACTGAGACACGGCCAGACTCCTACGGGAGGCAGCAGTAGGGAATCTCCGCAATAGGAGGAAAG TCTGACGGAGCAACGCCGCGTGAGTGATGAAGGCTTTCGGGTCGTAAAACCTGTTGTTAGGGAAGAACAAG TACAAGTAAGTGTGCTTGTACCTTGACGGTACCTAACAGAAAGCCACGGTAACTACGTGCCAGCAGCCG GGTAATACGTAGGTGGCAAGCGTTATCCGGAATTTATGGGCGTAAAGCGCGCCGAGGCGGTTTCTTAAAGTCT GATGTGAAAGCCACGGCTCAACCGTGGAGGGTCATTGAAAACCTGGGAACTTGAGTGCAGAAGAGAAAAG CGGAATCCACGTGTAGCGGTGAAATGCGTAGAGATGTGGAGGAACACCAGTGGCGAANGCGGCTTTTGGT CTGTAACGTGACGCTGAGGCGCGAAAGCGTGGGGAGCAAAACAGGATTAGATACCCTGGTAGTCCACGCGGTA AACGATGAGTGCTAAGTGTAGAGGGTTTCCGCCCTTATGCTGCAGCTAACGCATTAAGCACTCCGCTGG GGAGTACGGTCCGAAGACTGAACTCAAAGGAATTGACGGGGCCCGCACAAAGCGGTGGAGCATGTGGTTTA ATTCGAAGCAACGCGAAGAACCTTACCAGGTCTTGACATCCTCTGACAACCTAGAGATAGAGCGTTCCCTTC GGGGACAGAGTGACAGGTGGTGCATGGTTGTCGTCAGCTCGTGTGAGATGTTGGGTTAGTCCCGCACG AGCGCACCCCTGATCTAGTGCCAGCATTAAAGTGGGCACTCTAGTACTGCGGTGACCAAGAGGTTGGGATGA CGTCATCATCATGCTATAGCACTGGCTACACTACCGGTGGCCACACAATGA |