GLOBAL INITIATIVE OF ACADEMIC NETWORKS

Government of India
Ministry of Human Resource Development

Phytoremediation of Toxic Pollutants

29th May to 8 th June 2019

Sponsored by
Ministry of Human Resource Development (MHRD)
under
the scheme Global Initiative for Academic Network (GIAN)

Organized by

Centre for Biotechnology
Maharshi Dayanand University,
Rohtak-124001, Haryana,
INDIA

Phytoremediation of Toxic Pollutants

MHRD Scheme on Global Initiative on Academic Net work (GIAN)

Course-overview

Phytoremediation is the innovative use of plants and associated soil microbes to extract, sequester, and detoxify or immobilize elemental and organic chemical pollutants. It is an exciting and newly emerging field of plant biology/environmental biology/biotechnology that has tremendous potential to be used for cleaning up the polluted environment- soil, sediment, and water. Since phytoremediation is based on the concept of using nature to cleanse nature, it is gaining momentum as a sustainable, environmental-friendly "Green Clean" technology as an alternative to the environmentally destructive physical remediation methods such as excavation and reburial, incineration, or capping of toxic sediments. Since phytoremediation is solar energy-driven process, it is highly cost-effective and an *in-situ* treatment that preserve top soil, minimize environmental disruption and improve ecosystem habitat. Phytoremediation can be used to clean up metals, pesticides, solvents, explosives, crude oil, poly aromatic hydrocarbons, and landfill leachates. Plants have evolved a great diversity of genetic adaptations to handle the accumulated pollutants that occur in the environment. Plants are unique organisms equipped with remarkable metabolic and absorption capabilities, as well as transport systems that can take up nutrients or contaminants selectively from the growth matrix, soil or water. Phytoremediation involves growing plants in a contaminated soil, water and sediments for a required growth period to remove contaminants or facilitate immobilization (binding/containment) or phytodegradation (detoxification) of the pollutants. The plants can be subsequently harvested, processed and disposed. Phytoremediation has been successfully tested in many locations and successful outcomes have been achieved. Phytoremediation is currently gaining momentum in India. This is a very relevant course for Indian perspective given to the widespread contamination of heavy metals and organic pollutants, particularly arsenic issues in soil and drinking water. Further, biotechnology for developing "Climate-Resilient Crops" for producing safer crops by limiting the toxic pollutants in food crops including developing arsenic-free rice etc will be covered.

Objectives

The primary objectives of the course are as follows:

To expose participants to various aspects of phytoremediation, processes, type of pollutants that can be phytoremediated, and various strategies and mechanisms involved in the phytoremediation of a wide range of toxic pollutants, both organic and elemental. Also, to consider the economic and social issues related with the environmental pollutions and the proposed remediation strategies

To gain insight into biotechnology for developing "Climate-Resilient Crops" for producing safer crops by limiting the toxic pollutants in food crops including developing arsenic-free rice etc.

To discuss the practical problems and their solutions, through case studies and live projects.

3.0 Course details

3.1 Tentative Duration: May 29 to June 8, 2019 (10 days)

3.2 Tentative Lecture Schedule

Day 1 (May 29, 2019)

Lecture 1:10.00 to 11.000
Introduction to Phytoremediation, types and processes of phytoremediation, advantages and limitations of phytoremediation, Scope of phytoremediation- job market in academia, private and government sector.

Lecture 2: 11.30 to 12.30
Role of microbes in assisting phytoremeidation/ bioremediation, natural hyperacculator plants for metals and their limitations vs. transgenic approach.

Tutorial 1: 14.30 to 16.30
Tutorials based on above concepts

Day 2 (May 30, 2019)

Lecture 3 :10.00 to 11.000
Designing phytoremediation strategies- site assessment, choosing right plants, soil amendments, implementation, monitoring etc.

Lecture 4: 11.30 to 12.30
Physiological, molecular and biochemical mechanisms utilized by plants and microbes for uptake, transport and detoxification of pollutants.

Tutorial 2: 14.30 to 16.30
Tutorials based on above

Day 3 (May 31, 2019)

Lecture 5: 10.00 to 11.000
Arsenic poisoning in India and Bangladesh, arsenic contamination in water and food, Strategies and case studies for arsenic phytoremediation

Lecture 6: 11.30 to 12.30
Approaches to address arsenic accumulation in rice and vegetable, mechanisms of arsenic uptake, transport and accumulation in rice and developing arsenic free rice and other food crops

Tutorial 3.: 14.30 to 16.30
Tutorial based on above topics

Day 4 (June 1, 2019)

Lecture 7: 10.00 to 11.000
Phytoremediation of Mercury- background and toxicity problems, strategies to address mercury phytoremediation including biotechnological approaches.

Lecture 8: 11.30 to 12.30
Phytoremediation of Selenium (Se): overview and phytoremediation approaches

Tutorial 4: 14.30 to 16.30
Tutorial based on above topics

Day 5 (June 3, 2019)

Lecture 9: 10.00 to 11.000
Phytoremediation of Lead (Pb), cadmium (Cd) and Chromium (Cr): discussion and cases studies.

Lecture 10: 11.30 to 12.30
Phytomining: use of plants for mining of precious metals like gold and silver and stabilizing the abandoned gold mine sites, Socio-economic impact of phytomining on artisanal miner communities.

Tutorial 5: 14.30 to 16.30
Tutorials based on above

Day 6 (June 4, 2019)

Lecture 11: 10.00 to 11.000
Phytoremediation of organic pollutants- chlorinated solvents such as TCE, PCE, PCBs; Toxicity of organic pollutants and environmental impact.

Lecture 12: 11.30 to 12.30
Green liver concept for phytoremediation of organic pollutants and role of plants enzymes in degradation and remediation of organic pollutants

Tutorial 6: 14.30 to 16.30
Tutorials based on above

Day 7 (June 5, 2019)

Lecture 13: 10.00 to 11.000
Phytoremediation of volatile halogenated hydrocarbons (TCE, carbon tetrachloride, benzene etc): overview and strategies

Lecture 14: 11.30 to 12.30
Phytoremediation of volatile halogenated hydrocarbons (TCE, carbon tetrachloride, benzene etc): case studies and field applications

Tutorial 7: 14.30 to 16.30
Tutorials based on above

Day 8 (June 6, 2019)

Lecture 15: 10.00 to 11.000
Phytoremediation of explosive nitro-aromatic compounds (TNT, RDX, HMX): toxicity and overview.

Lecture 16: 11.30 to 12.30
Strategies and case studies for phytoremediation of explosive nitro-aromatic compounds (TNT, RDX, HMX).

Tutorial 8: 14.30 to 16.30
Tutorials based on above

Day 9 (June 7, 2019)

Lecture 17: 10.00 to 11.000
Phytoremediation and bioenergy- dual use or plant biomass.

Lecture 18: 11.30 to 12.30
Nanotechnology- Engineered nonmaterial's toxicity in plants, environment, trophic transfer in food chain and food safety issues; strategies to detoxify and minimize the impact on environment,

Tutorial 9: 14.30 to 16.30
Tutorials based on above

Day 10 (June 8, 2019)

Lecture 19: 10.00 to 11.000
Strategies to address climate change impact of global food security and developing climate-resilient crops

Lecture 20: 11.30 to 12.30
Transgenic plants for phytoremediation, bioenergy and food: theory and practices; facts, myths and controversies about genetically modified plants.

Tutorial 10: 14.30 to 16.30
Tutorials based on above

Date of Examination: June 8, 2019

4.0 Who can attend?

Executives, engineers and researchers from manufacturing, service and government organizations including R&D laboratories.
Student students at all levels (BTech/MSc/MTech/PhD) or Faculty from reputed academic institutions and technical institutions.

5.0 Course Fee

The participation fee for taking the course is as follows:
Participants from abroad: US$ 500
Industrial Participants: INR 15,000/-
Participants from Indian Academic Institutions/Research Organisations/Faculty: INR 4,000/-
Research Scholars: INR 2,000/-; Students: INR 1,000/- .
The above fee include all instructional materials, computer use for tutorials and assignments, laboratory equipment usage charges, 24 hr internet facility. The paid hostel/guest house accommodation may be provided to out-station participants with prior request.

6.0 How to participate:

Register yourself at GIAN WEB PORTAL (http://www.gian.iitkgp.ac.in/gregn/index)
Choose course, *i. e.* "Phytoremediation of Toxic Pollutants" by drop down menu
Fill the **registration form** and pay the course fee (which is separate than the registration fee) by DEMAND DRAFT (drawn in favor of the Finance Office, MDU, Rohtak) or NEFT/RTGS at SBI A/C No. **37868756829,** IFSC: SBIN0004734)
Scan filled registration form and send to the course coordinator(jaiwalpawan@rediffmail.com)

Foreign Faculty

Dr. Om Parkash Dhankher is a Professor of Agriculture Biotechnology in the Stockbridge School of Agriculture, University of Massachusetts, Amherst (U.S.A.). He received his M. Sc. and M. Phil. in Botany from Kurukshetra University (India) and Ph.D. in Plant Molecular Biology from Durham University (United Kingdom). He was the recipient of the prestigious Commonwealth Scholarship by the Commonwealth Commison London, for Ph.D. degree at Durham University under the guidance of Prof. John Gatehouse at the Durham University. In 1998, Prof. Dhankher joined the University of Georgia (USA) as a Postdoctoral Research Associate and later as Assistant Research Professor in the Department of Genetics where he developed the first transgenic plant based approach for arsenic phytoremediation by combining the expression of two bacterial genes. In 2004, Dr. Dhankher joined the tenure-track faculty position at the University of Massachusetts Amherst and currently working as a Professor. His research focus is multidisciplinary in nature ranging from crop improvements, phytoremediation to biofuels. Along with strong research in engineering plants for detoxification and phytoremediation of heavy metals, his laboratory is developing arsenic free and arsenic tolerant food crops in order to improve human health using both forward and reverse genetic approaches. Additionally, his research team is developing 'climate resilient crops' for improving yields via manipulating key pathways and network of genes responsible for enhanced tolerance to multiple abiotic and oxidative stresses and GSH homeostasis. Prof. Dhankher has published more than 90 publications in high impact factor journals including *Nature Biotech*, *Nature*, *PNAS, The Plant Cell*, *Plant Physiology*, *New Phytologist*, *Plant Biotechnology J.* etc. and six international patents awarded to him.Prof. Dhankher is an Editor, Associate Editor and member of editorial board of several international journals including the*International Journal Phytoremediation, International Journal Plant Biology Research, Frontier's Agricultural Biological Chemistry, International Journal of Plant and Environment.*He is alsoan elected fellow of Indian Society of Plant Physiology and a member of the Executive Committee of the American Society of Plant Biologists (ASPB). Prof. Dhankher has supervised over two dozen Ph.D. and M.Sc. students, visiting Professors, and postdoctoral Research Associates. He teaches several courses including Phytoremediation, Introductory Molecular Biology Laboratory, Agricultural Biotechnology, and GMOs: Facts, Myths and Controversies. Prof. Dhankher has several ongoing collaborations with researchers in India, China, Italy, Egypt, and USA.

Course Coordinator

Professor Pawan K. Jaiwal is presently working as a UGC-BSR Faculty Fellow in the Centre for Biotechnology, M. D. University, Rohtak-124001, India. He joined M. D. University as a Lecturer, in Plant Sciences in the year, 1986. Since than he served the University at various positions as a Senior lecturer, Reader, Professor and the Director of the Centre for Biotechnology, M. D. University, Rohtak from 2012-2015 and Dean, Faculty of Life Sciences from 2014-17 and participated in various committees and statuary bodies of the University time to time as chairman or member. He has nearly 32 years of the post-graduate teaching experience. Dr Jaiwal has contributed **15 books** published from Kluwer Academic Publishers, Dordrecht, CAB International, UK and Springer, Heidelberg, **30 book chapters and review articles, and 105 original research papers** in National and International reputed and referred research journals. He is on the Editorial Board of **four** International research journals. He has guided more than 68 students for M.Sc. and M. Phil. and **24 students for Ph. D. degrees**. He has successfully completed **12 major research projects** funded by various National and International agencies. Dr Jaiwal has been awarded Young Scientist Project by DST, INSA Visiting Fellowship by INSA, New Delhi, DBT overseas Associateship by DBT, New Delhi and Prof H S Srivastava Gold medal by the National Academy of Environmental Sciences, Lucknow, India. He has worked at the Institute of Plant Sciences, ETH, Zurich, Switzerland, National Research Centre on Plant Biotechnology, New Delhi and at the University of Ghent, Ghent, Belgium. He has visited NIAS, Tsukuba, Japan, Chinese Academy of Agricultural Sciences, Beijing and University of Massachusetts, Amherst, USA for collaborative research. His current research interests are metabolic engineering for resistance to abiotic and biotic stresses, nutrient use efficiency and nutritional quality improvement in pulses especially *Vigna* species, oil crops (Indian mustard and Sesame) and cereals (wheat).

Course Co-coordinator

Dr. Anil Kumar Chhillar is working as a Professor and Director in the Centre for Biotechnology, M. D. University, Rohtak, India. He did his Ph. D. from Kurukshetra University, Kurukshetra, India and post doc from CSIR-Institute of Genomics & Integrative Biology (**IGIB**), New Delhi and Medical University, Innsbruck, Austria. His main areas of research interest are antimicrobials and proteomics. He has guided 13 students for their Ph.D. theses and published 80 research papers in reputed high impact factor journals. He has successfully completed several research projects. He is coordinator of UGC-SAP and DST-FIST programs. He is also the Chairman of Institutional Animal Ethics Committee and Institutional Biosafety Committee.

Local Coordinator: **Prof. J. P. Yadav**
Department of Genetics, M. D. University, Rohtak-124001

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Government of India
Ministry of Human Resource Development

Phytoremediation of Toxic Pollutants

(Course Code: 176021H06)

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Under the scheme Global Initiative for Academic Network (GIAN)

29th May to 8 th June 2019

REGISTRATION FORM

PERSONAL DETAILS

Name of the Applicant : _____

Designation : _____

Institution Address : _____

_____

E-mail : _____

Mobile Number : _____

Paste recent passport size coloured photograph

REGISTRATION FEE DETAILS

By Cheque

Amount (INR) : _____

Account Number : _____

Account Holder's Name : _____

Cheque No. & Date : _____

By NEFT

Amount (INR) : _____

Account Number : _____

Account Holder's Name : _____

Transaction ID & Date : _____

By Demand Draft

Amount: _____ DD No. _____

Bank: _____ Date: _____

Signature

Note:

•Registration should be made in favour of **GIAN, M.D. University, Rohtak** A/c via cheque/online transfer mode only. (**Bank Name & Address**: SBI, Rohtak-124001; **Account No. 37868756829; MICR 124002008; IFSC SBIN0004734**)

•Proof of Registration fee should be sent to Prof. Pawan K. Jaiwal, Centre for Biotechnology, M.D. University, Rohtak-124001, Haryana.

•The scanned copy of filled Registration form duly signed by the applicant along with the proof of fee submission should also be sent by E-mail to Prof. Pawan K. Jaiwal (jaiwalpawan@rediffmail.com)

•In case the candidate requires an accommodation a separate E-mail regarding this should be sent to (jaiwalpawan@rediffmail.com) before April 30, 2019.

CONTACT PERSON

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