

**INTERNATIONAL CONFERENCE**

**on**

**ENVIRONMENT, WATER, AGRICULTURE,  
SUSTAINABILITY AND HEALTH (EWASH-2021):  
UNITED TOGETHER IN THE BATTLE AGAINST PANDEMIC**

**&**

**3<sup>rd</sup> Annual Meet of STE**

**ONLINE**

**21<sup>st</sup> - 22<sup>nd</sup> January, 2022**

**Protect the blue and green - Make the Earth pristine**

**Jointly Organized by STE & Hindu College**



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**ABSTRACT BOOK**

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# India lives in its villages

- Mahatma Gandhi



“ Powering rural India,  
Empowering the masses ”



Development Bank of the Nation for Fostering Rural Prosperity

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"The financial assistance received from Research and Development Fund of National Bank for Agriculture and Rural Development (NABARD) towards publication of journal/ printing of proceedings of the Conference is gratefully acknowledged".

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## **MESSAGE**



I am very happy to learn that an online International Conference on 'Environment, Water, Agriculture, Sustainability & Health (EWASH-2021): United Together in The Battle Against Pandemic' (January 21-22, 2022) is being jointly organized by Save The Environment (STE)- 'A Society for Research, Awareness and Social Development', Kolkata, and Department of Chemistry, Hindu College, New Delhi. These significant issues being addressed in this conference are intertwined with each other and they hold special prominence given their critical role in well-being of the humanity.

I hope that this meeting will bring together experts who could ideate and collaborate on important environmental issues in order to provide innovative solutions and implementable approaches for a myriad of challenging problems.

I wish EWASH-2021 a great success.

**Prof. Sandeep Verma**

Science and Engineering Research Board  
Department of Science & Technology  
Govt. of India

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## MESSAGE



Due to Covid-19 pandemic, the World is facing a challenging time for almost two years now, despite many countries including India have made significant achievements in tackling the situation. One very important lesson learnt due to the situation is the understanding that how much we really need to live a comfortable life.

With continuous increase in population, worldwide and in India as well, the pace of development required to meet the needs and aspirations of people has put tremendous pressure on the natural resources and in-turn on the mother Earth. Whereas, all the resources shall remain limited in the universe and cannot be enhanced. The only possible way is to continuously evolve new technologies/processes that use lesser resources and generate more products to meet the continuously increasing requirements, while minimizing/ eliminating the wastes generation. Even the minimal wastes generated that are not understood how to be utilized today, need to be put back to the environment within its assimilative capacity, as these will become resources for future generations.

It is indeed a pleasure that "SAVE THE ENVIRONMENT", a Society for Research, Awareness and Social Development, Gurugram along with Hindu College, University of Delhi, Delhi, CSIR-NEERI Delhi Zonal Centre, The Royal Society of Chemistry, North India and ESDA, Delhi is organizing two days International Conference on "Environment, Water, Agriculture and Health (EWASH-2021): Together in the Battle against Pandemic" during January 21-22, 2022, to discuss and deliberate various key environmental challenges, particularly under the pandemic scenario.

I am sure with the participation and deliberations by various stakeholders including the subject experts, academicians, researchers, students and policy makers in the conference will help positively in

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addressing the national as well as global environmental challenges leading to attain sustainable development by protecting environment, enhancing agriculture growth following natural practices, conserving water resources for the better health of the society, even in this changed scenario.

I congratulate the Organizers and wish the Conference a Grand Success.

**Dr. S.K. Goyal**  
Chief Scientist & Head  
CSIR-National Environmental Engineering  
Research Institute, Delhi Zonal Centre

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**MESSAGE**



I am delighted to welcome all delegates to this International Conference on “Environment, Water, Agriculture, Sustainability & Health (EWASH-2021): United Together in The Battle Against Pandemic” jointly organized by Save The Environment (STE)- 'A Society for Research, Awareness and Social Development' located at Kolkata, West Bengal, India and Dept. of Chemistry, Hindu College, Delhi, India in association with Royal Society of Chemistry, London North India Section and Environment & Social Development Association (ESDA), Delhi.

Unfortunately, the spread of COVID-19 has not come to an end yet. But, it is believed that through a collaborative approach and united efforts the pandemic will soon be over. With this objective in mind, the present International Conference is being organized amidst the ongoing global pandemic which requires grave thinking, cooperative introspection and analysis on the thematic areas of the present conference. This would provide an excellent platform for growing researchers to explore areas of collaborative endeavors and to share latest cutting-edge research findings with the international community through oral and poster presentations. Being the Honorary Secretary of RSC London North India Section and the Coordinator of Green Chemistry Network Center, I believe that organizing scientific conferences is the best way to aspire young generations towards environmental sustainability and to solve such grave global issues.

It is my firm belief that through this conference, we will be able to generate productive deliberations culminating into useful recommendations in addressing the current issues related to environment, water, agriculture, sustainability and human health. I would like to congratulate the entire team especially the convener Dr. Kshipra Misra (President, STE & Ex Addl. Dir., DIPAS (DRDO), Delhi) for

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her excellent efforts and for contributing immensely towards making this event a reality. Last but not the least, my sincere thanks to all the participants for helping in accomplishing the objectives of EWASH-2021.

My best wishes for the great success of the conference.

**Prof. R. K. Sharma**

Honorary Secretary, RSC London-North India section  
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## MESSAGE



As the entire world still continues to struggle with the global pandemic “COVID-19”, the realization that “what we have given to our mother earth and society has come back” has grown stronger!! Every surpassing day, the need to completely revisit our single track approach towards increased productivity to satiate our needs as well as greed without giving due attention to the repercussions of these actions on environment and human health acquires even more prominence. This is where the conference entitled “E-Wash” becomes meaningful! The previous year had already set the bar high with meaningful and impactful lectures, excellent scientific deliberations and it was truly an overwhelming experience for all of us! E-Wash 2020 was referred as the outcome based workshop where all of us got together and came up with efficient and sustainable solutions for mitigating some of the current environmental challenges. We are once again uniting this year for the E-Wash 2021, but with a rejuvenated focus towards furtherance of our mission of greening the planet earth! I am assured of the fact that the collaboration of the organizing partners especially STE and Hindu College will prove to be highly fruitful once again! I would like to especially thank Dr. Kshipra Misra, the president of STE who has extended extensive support towards organizing this conference. Also, my deep gratitude goes for

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Prof. R. K. Sharma, Co-ordinator of GCNC and Honorary Secretary, RSC London North India Section, who has also supported us extensively in all our endeavours.

Lastly, I feel delighted to welcome all the delegates and participants to this event who will add a real value to the “E-Wash 2021.” Let us all get engaged in the real sense and contribute effectively towards the goals of the conference!

**(Prof. Anju Srivastava)**  
Principal, Hindu College

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I would like to begin with a beautiful quote that is highly inspirational and raises our consciousness towards saving the environment “We don't have a society if we destroy the environment.” To render a safer planet is the duty of every individual and it is high time we get to grave thinking and put our thoughts into action! Although many of us have realized that economic growth and environmental protection should go hand in hand, yet there is a still a gap in this understanding which can be portrayed wondrously through meaningful conferences like E-Wash that has an ultimate objective of coming up with sustainable solutions for many of the environmental challenges on the horizon. We are all entering into the second year of E-Wash which is also the third annual meet of STE which is aiming towards providing a unique platform for bringing together educators, scholars, eminent scientists, government authorities, policy makers and experts from across the globe to exchange knowledge and ideas on the recent advances in conservation and protection of environment with special focus on clean water management and good agricultural practices for sustainable development. This conference includes impactful keynote & invited lectures, oral & poster presentations as well as interesting student activities.

As the convener of E-Wash 2021 and president of STE, I feel so delighted to welcome all the delegates to contribute towards the goals of the conference. I am so thankful to Prof. Sandeep Verma for accepting our request to grace the event as the Chief Guest of the inaugural session. With due respect, I would also like to thank Shri Sanjeev K. Varshney ji for agreeing to be an integral part of the event as the chief guest of the valedictory session and always being highly supportive in all our endeavours. I cannot forget to thank all the keynote and invited speakers who have directed tremendous efforts

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towards motivating everyone through their enlightening talks! My gratitude also goes for Prof. Arunabha Majumdar-our chief patron, Prof. R. K. Sharma, Prof. Anju Srivastava and Dr. S. K. Goyal-our co-patrons, Prof. Reena Jain- convenor, the co-convenors, organizing secretaries as well as others who helped extensively towards organizing this event!

I am truly assured of the fact that we will not stop here but continue with our steps towards conserving our mother nature. The ultimate truth is “The natural world is changing and we are totally dependent on that world. It provides our food, water and air. It is the most precious thing we have and we need to defend it.”

“Let us all try to leave the earth a better place than when you arrived.”



**Dr. Kshipra Misra**

Convener, EWASH-2021;

President, STE & Former Addl. Director, DIPAS (DRDO), Delhi

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## MESSAGE



I am delighted to welcome all the delegates to this International Conference on “Environment, Water , Agriculture, Sustainability and Health (EWASH- 2021): United Together in the Battle against Pandemic” & 3rd Annual Meet of Save The Environment. It is indeed a matter of pride that Save The Environment has taken an initiative along with co-organisers CSIR-NEERI, RSC London North India Section, ESDA, and Chemistry Society, Hindu College to provide a platform where in the experts will share their knowledge with the young researchers, scientists, trainers and educators across the globe.

It is the second time in row that the conference is being organized in virtual mode, due to the conditions arising out of the Covid–19 pandemic. It is almost for two years now that we have been struggling to win over this virus, which further forces us to think, rethink, introspect and analyse on the theme of the conference. The sustainability of our contemporary global order is a matter of intense debates and discussions and can be addressed by interdisciplinary education framework. This conference will provide a valuable forum for the sharing of research work, cutting across disciplinary boundaries. The conference would also provide an academic platform for encouraging discussions and discourses, exchange of knowledge so that together we can anticipate a future of knowledge and research to Heal our Mother Earth and the Environment. Further, the conference will also give the participants an opportunity to share their novel ideas through Paper and Poster Presentations.

I am confident that in this Conference, we will have healthy and fruitful discussions, which will be helpful in addressing the current issues related to environment, water, agriculture, sustainability and health.

I would like to thank Dr Kshipra Misra, President STE and Former Additional Director, DIPAS (DRDO), Delhi, for extending all possible support in organizing this conference. I would also like to

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thank Prof R K Sharma , Honorary Secretary, RSC London-North India Section and co-ordinator GCNC, Delhi University for his guidance for the organization of the conference. I am also grateful to our Principal, Prof Anju Srivastava for her support, motivation and encouragement for organizing this event. I would also like to congratulate the entire organizing team for their tireless efforts towards the organization of this conference. Last but not the least, I would like to thank all the participants for helping us in accomplishing the objectives of this Conference.

**Dr. Reena Jain**

Vice-Principal, Hindu College  
University of Delhi Delhi – 110007  
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## **ABOUT THE ORGANIZERS**

### **SAVE THE ENVIRONMENT (STE)**

Save The Environment (STE) was founded and registered on 19<sup>th</sup> November 1990 [Reg no. S/66/489 of 1990-91]. Since then, STE has been privileged to collaborate with organizations and departments of repute, like WWF (India), AIIPH, Indo-Canada environment facility, DST and DRDO to counter the long standing issue of arsenic poisoning of water, especially in rural areas of West Bengal, India. STE has also been actively engaged in spreading awareness among general public for environment protection and water management.

For further details please visit: <http://stenvironment.org>

### **HINDU COLLEGE, UNIVERSITY OF DELHI, Delhi**

Estd. in 1899, Hindu College, University of Delhi is one of the most distinguished co-educational institutions of India. Accredited with A+ grade by NAAC, Hindu College boasts of modernistic infrastructural facilities and dedicated educators aiming to provide a perfect platform for education & research and a holistic environment for co-curricular pursuits to its pupil. The Chemistry department of Hindu college is one of the most renowned departments at University of Delhi. It commits to inculcating scientific values aiming for the pursuit of research. The faculty, apart from providing top-notch mentorship is also known for active involvement in impactful research projects and book publications. The department boasts of a vibrant co-scholastic society, 'TATVA' where student-teacher interactions go beyond the course curricula, encompassing enriching lectures, seminars and workshops for the students.

For further details, please visit: <http://www.hinducollege.ac.in/>

### **NATIONAL ENVIRONMENTAL ENGINEERING RESEARCH INSTITUTE (NEERI)**

National Environmental Engineering Research Institute (NEERI), is a constituent of Council of Scientific & Industrial Research (CSIR), New Delhi and has a nation-wide presence. It strives for application of Engineering for Sustainable Development. It provides innovative and effective solutions for environmentally sustainable development.

For further details please visit: <https://www.neeri.res.in>

## **THE ROYAL SOCIETY OF CHEMISTRY LONDON-NORTH INDIA SECTION**

The Royal Society of Chemistry North India section organizes various activities for the advancement of chemical sciences. This includes lecture series, meetings and workshops on green/ sustainable chemistry, etc. for students, educators and scientists.

For further details please visit: <https://www.rsc.org>

## **ENVIRONMENT AND SOCIAL DEVELOPMENT ASSOCIATION (ESDA), Delhi**

Environment and Social Development Association, Delhi is a non-government and non-profit based national organization, principally dedicated to enhancement of public awareness on preservation and up gradation of environment and management of all forms of air, waste, water and river conservation etc.

For further details please visit: <http://www.esdaindia.org>

## ORGANIZING COMMITTEE

### Chief Patron

- **Prof. Arunabha Majumder**, Emeritus Professor, Jadavpur University, Kolkata and Former Director, AIIPH, Kolkata

### Co- Patrons

- **Prof. R.K. Sharma**, Honorary Secretary, RSC London-North India section
- **Prof. Anju Srivastava**, Principal, Hindu College, University of Delhi, Delhi
- **Dr. S.K. Goyal**, Chief Scientist & Head, CSIR-NEERI, Delhi Zonal Centre

### Conveners

- **Dr. Kshipra Misra**, President, STE & Ex Addl. Dir., DIPAS (DRDO), Delhi
- **Prof. Reena Jain**, Vice Principal, Hindu College, University of Delhi

### Co-conveners

- **Mrs. Chhanda Basu**, General Secretary, STE
- **Dr. Jitendra Nagar**, General Secretary, ESDA, New Delhi
- **Dr. Charu Kumar**, Associate Professor, Hindu College

### Organizing Secretaries

- **Dr. Jigni Mishra**, Project Associate, IARI & E.C. Member, STE
- **Dr. Devanshi Magoo**, Assistant Professor, Chemistry Dept., Hindu College
- **Mr. Ajai Kumar**, Associate Professor, Chemistry Department, Hindu College

### Co-organizing Secretary

- **Dr. Sandhya Mishra**, Associate Professor, C.C.S University, Meerut/NREC College, Khurja, U.P.

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- **Anukriti Sharma**, Vice President, Tatva

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- **Mr. Sanjit Mitra**, Treasurer, STE
- **Mr. Dipankar Chakraborty**, Jt. Secy., STE
- **Mr. Gian Chand**, Conf. Secretariat

### **From NEERI**

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- **Dr. Papiya Mandal**, Sr. Scientist
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- **Dr. Anil Kumar Mavi**, Vallabhbhai Patel Chest Institute, University of Delhi
- **Dr. Mehjabeen Afaque**, Sect., ESDA (Delhi Chap.) & Trainee, IARI, Delhi
- **Dr. Sonam Dutta**, Assistant Professor, BRAC, University of Delhi



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# **Abstracts**

# INVITED TALKS



# OPENING REMARKS

## POLLUTION: ISSUES AND CONCERNS

**Dr. Arunabha Majumder**

Chairman, Indian Water Works Association (IWWA) and Ex Director  
Professor & Head, Department of Sanitary Engineering, AIHH&PH, Kolkata and  
Guest Professor, School of Water Resources Engg., Jadavpur University.

Developmental activities may cause environmental degradation leading to adverse impact on public health. Any factor whether biotic or abiotic contributing to the degradation of environment is pollution. So, change of physical, chemical or biological properties of water rendering it unsuitable for use is water pollution. In India, rivers are getting polluted due to discharge of untreated or partially treated sewage/ sullage and industrial wastes water, mixing of surface runoff carrying pesticides, insecticides and agricultural wastes, discharge of cattle-shed waste, dumping of solid waste etc. Many stretches of different rivers are showing increase of BOD, depletion of dissolved Oxygen, detrimental condition to fish life and risk for human use. Uncontrolled and uncared disposal of untreated industrial effluent and sludge is causing groundwater pollution in many industrial belts. The deterioration in surface and groundwater quality causes adverse impact on public health.

Majority of the population of our country depend on groundwater for drinking. Arsenic and fluoride contaminations in groundwater have been detected in many regions. Considerable numbers of people are suffering from arsenicosis or fluorosis due to drinking arsenic or fluoride contaminated water for a prolonged period. In many regions, nitrate is increasing in groundwater causing concern to newborn babies. Overdraw of groundwater has deteriorated groundwater quality in many regions resulting in higher dissolved solids, iron, hardness, salinity, arsenic and fluoride contamination. Increasing disease burden due to bacteriological contamination of drinking water is showing higher illness time and economic loss.

Air pollution in urban centres is increasing due to uncontrolled emission from thermal power plant, industry, transport, domestic and construction sectors. Acute respiratory infection, asthma, cough, eye irritation etc. are very common to urban population due to air pollution.

Uncontrolled disposal of solid waste in cities and towns is causing water pollution due to leachate, air pollution and fire hazards. Rodent and fly nuisance are common around the solid waste disposal site.

Every effort needs to be taken for control of pollution by adopting appropriate technology in the pollution control system. The statutory authorities should carry out proper monitoring and surveillance for control of pollution. Industries, municipal authorities and other stakeholders should be motivated and urged to manage pollution control systems effectively as well as efficiently. People, at large must be aware of environmental ethics and discipline.

# INVITED TALK

## **DECIPHERING THE PUZZLE OF HYPOBARIC HYPOXIA: PROTEOMICS, PROPHYLAXIS AND MODELLING APPROACH**

**Yasmin Ahmad**

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Hypoxia, particularly hypobaric hypoxia, is a multifaceted entity which includes certain molecular, pathophysiological and biochemical aspects. Any single aspect in itself cannot help us elucidate hypobaric hypoxia in its entirety. We observed three crucial lacunae within the existing literature. These include a lack of high-throughput proteomics investigations related to hypobaric hypoxia, supplement with proven efficacy and safety which doesn't involve medical supervision and is not contraindicated in hepatic, renal and cardiac insufficiencies; and a clinically validated rodent model of HAPE without any genetic/pharmacological manipulations. In the present study, the focus was to understand and propose a model for rapid acclimatization based on molecular changes. Then we presented a micronised aqueous suspension of silymarin which is efficacious at low doses in providing antioxidant, anti-inflammatory and hypoxia adaptive vascular responses in addition to being a free radical quencher itself. Silymarin has an excellent safety and efficacy profile in humans. Finally, we create a SD rat model of HAPE which was used to reverse-translate a previously known HAPE marker in humans (SULT1A1) and elucidate the synergistic occurrence of HAPE and inflammation cascades. This is the first radiologically validated rodent HAPE model. In conclusion, we were able to elucidate the molecular, biochemical and pathophysiological aspects of hypobaric hypoxia which were left out by previous studies.

# INVITED TALK

## SEMI-QUANTITATIVE THIN-LAYER CHROMATOGRAPHY– DIRECT BIOAUTOGRAPHY OF BIOACTIVE FOOD AND WATER CONTAMINANTS

**Irena Maria Choma**

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Thin-layer chromatography (TLC) is a well-established simple and flexible method for qualitative and quantitative analysis of many samples in parallel. TLC “fingerprints” show visual differences among samples of various type, origin and quality. Moreover, TLC, which is an open system, allows to perform bioassays directly on a TLC plate (so-called TLC-direct bioautography) and convenient hyphenation with spectroscopic methods to detect bio active compounds: antimicrobials, antioxidants, estrogens and enzyme inhibitors. TLC-DB belongs to effect directed analysis (EDA) methods and may be used for searching biologically active substances even in very complex matrices (1-3).

TLC-DB can be also used as a semi-quantitative method (1,2). This aspect of the TLC-DB is not well-known and not used very often. In the presented lecture semi-quantitative TLC-DB will be discussed in detail basing both on the literature and the experimental results. Various matrices (milk, water, plants) will be taken into consideration. The focus on the type of calibration curves (linear, exponential, sigmoidal) will be done in relation to the bioassay applied.

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# INVITED TALK

## NANOTECHNOLOGY AND MAGNETIC FIELD IN WATER PURIFICATION

**I. Malinowska, M. Studziński**

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The development of civilization results in an increase in the quality of life, what caused, among other things, in an increase of life expectancy in countries with a high level of development. However, the development of civilization also has negative effects. The emergence of large human clusters and the development of the industry results in the emission of many substances harmful to the natural environment.

Many dangerous substances get into the environment in the form of wastewater, either from industrial plants or from municipal wastewater. Thus, the problem of water purity - it is now a global problem. Water quality affects the functioning of the entire ecosystem into which it feeds. Many methods of water purification have been developed, depending on the type of contamination, various physical and chemical phenomena are used for this purpose. In case of chemical and biological contaminations, sorption is often used method to remove them. The polluting substances are adsorbed on solid adsorbents and together with them removed from the wastewater. Therefore, one of the directions of research on water purification is the investigation on new sorption materials that would not only effectively remove harmful substances, but also can be easily removed from the system.

The nanomaterials having a high surface to volume ratio seem to be an attractive adsorption materials. The possibility of tailoring for specific application, their size and surface properties make them competitive to other adsorptive materials. Moreover, magnetic nanomaterials may additionally, have an additional advantages comparing to regular sorption materials. Using external magnetic field they can be easily removed from the solution.

In the presentation, the sorption properties of core shell nanoparticles for isolation of different groups of pollutants such as: heavy metal ions, pesticides, dyes, phenolic compounds and biological as bacteria, viruses, molds, and different mode of magnetic field used for isolation of nanoparticles from water are discussed.

# INVITED TALK

## HYDROPONICS FOR ENVIRONMENT CONSERVATION

**Shashank Agarwal**

Randgrow Corporation, Kolkata, India

The technology introduced here for environmental conservation is hydroponics. Hydroponics is a combination of two words hydro meaning water and ponies means to work hence hydroponics stands for water working. It is the sustenance of crop yield through use of liquid nutrients. The water used for hydroponics contains dissolved liquid nutrients which are fed directly to the roots of the crops. The crops absorb the required nutrients for their growth cycle and grow without any deficiency symptoms whatsoever. Various micro nutrients such as magnesium, calcium, nitrogen, potassium, phosphorus, sulfur etc are provided in milligrams to the plant according to their growth cycle. Hence the crops receive a fix quantity of nutrients for their growth which enables them to grow and expand without succumbing to any deficiency symptoms what so ever Traditional soil based farming systems involves the use of urea and DAP which increases the quantity of nitrogen in the soil and contaminates the water present in underground aquifers. This contamination can spread to nearby water bodies such as lakes, rivers and streams leading to eutrophication, stagnation and death of aquatic life. This will make the water unfit for consumption by biotic organisms and the contamination can spread to larger water bodies such as the sea and oceans causing Dominic acid poisoning leading to the death of aquatic life forms. Traditional farming also involves the growth of crops in furrows hence it will require more land for the growth and production of crops. However in hydroponics, the crops can be grown in vertical troughs and be stacked one on top of each other hence less area is required thereby reducing the area required for farming. The will indirectly save the forest terrain from clear cutting for farm land and make farming possible near urban areas. Hydroponics as it consumes less land surface can also be possible inside poly houses which regulate the temperature thereby enhancing the production of crops during all seasons. This makes growth and production of temperate crops more favourable during the summer season thereby providing a steady supply of temperate and tropical crops all year around Hydroponics provides us with the best means to grow crops near and within urban premises that to in minimum land areas thereby generating employment opportunities in terms of production and processing of food. It also reduces transportation of food material thereby minimizing food mileage, traffic congestion and food wastage due to rotting during transportation. Hence hydroponics can generate employment opportunities for farmers who seek to reside in urban areas. This will reduce the impact of farming on bio diversity as it provides farmers with the best means to bring the farm into the city and cultivate crops in vertical sky rises thereby saving valuable forest terrain from deforestation I wish to promote and commercialize hydroponics for the current and future generations which will enable them to generate income opportunities without depleting our natural heritage.

# INVITED TALK

## Exploring Radiation Chemistry and Chemistry of Advanced Oxidation Processes: Implication to Radiation Biology, Radiotherapy and Environmental Remediation

Samuel Ward,<sup>a</sup>David Becker,<sup>a</sup>Victor Ngyuen,<sup>a</sup> Anil Kumar,<sup>a</sup>Roman Dembinski,<sup>a</sup>Michael D. Sevilla,<sup>a</sup>Stanislaw Wnuk,<sup>b</sup>Thomas Baumann,<sup>c</sup>Melanie Coathup,<sup>d</sup>Sudipta Seal,<sup>d</sup>Miral Dizdaroglu,<sup>e</sup> Mehran Mostafavi,<sup>f</sup>Amitava Adhikary<sup>a</sup>

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Our ongoing studies of irradiated DNA have led to a comprehensive model of radiation-induced DNA damage. This model describes physicochemical events from the initial deposition of energy to DNA ion-radical-excited state formation through hole and electron transfer, to chemical events involving free radical processes that lead to secondary radicals which result in DNA damage such as base and sugar damage, strand scission, and concurrent base release. Employing samples of hydrated ( $G = 12 \pm 2$  water molecules/nucleotide) DNA emphasizes direct-type (direct plus quasi-direct) effects. Sugar radicals formed in the DNA sugar-phosphate backbone are immediate precursors of radiation-induced DNA-strand breaks that may lead to cell death, mutation, and subsequent neoplastic transformation. The very high global concentration (65 to 220 mg/ml) of macromolecules (DNA, RNA, proteins etc.) in the cell nucleus makes the role of direct-type effects of radiation in cells of crucial importance. This makes formation of sugar radicals via the “direct ionization followed by deprotonation” pathway of the sugar-phosphate backbone in DNA owing to the direct-type effects important. Our studies employing synthesis (OU), electron spin resonance (ESR) spectroscopy at low temperatures (OU), pulse radiolysis at room temperatures (ELYSE), measurements of associated unaltered base release in the same samples at room temperature (OU), GC-MS/MS and LC-MS/MS studies (NIST), and theoretical (DFT) calculations of radical mechanisms (OU) have unraveled further mechanisms of DNA-sugar radical formation via direct-type effects, viz. (i) sugar radical formation via excitation of DNA base cation radicals and (ii) strand breaks via dissociative electron attachment induced by low energy electrons (LEE). In addition, we find that chemical radiomodifiers increase or decrease the yields of initially formed DNA-radicals that are precursors of strand breaks, e.g.,

- (I) **Electron-induced site specific formation and reactions of pi-aminyl radicals in azido-nucleic acid models:** These aminyl radicals can undergo various reactions, e.g., H-atom abstraction, bimolecular conversion and tautomerization to sigma-iminyl radicals, etc. Aminyl and iminyl radicals are well-known to cause DNA damage via oxidative pathway. Thus, these azido-nucleosides are potential radiosensitizers.
- (II) **Investigation of the chemical pathways of radiomodification by engineered nanoceria (CeO<sub>2</sub> nanoparticles):** We employ nanoceria-DNA to investigate how and to what extent nanoceria modify radiation damage processes in DNA. Recently, we found that in irradiated nanoceria-DNA samples (1 CeO<sub>2</sub> nanoparticle/10 bases), nanoceria provide near-complete protection against

radiation-induced unaltered base release (a surrogate for measurements of radiation-induced DNA strand breaks). Nanoceria show potential use as radioprotectors.

- (III) Advanced oxidation processes involve hydroxyl radical (OH-radical) reactions for the removal of primarily organic (and in some cases, inorganic) matters in water and in oil samples. We are establishing a laboratory at Oakland University with a mission to apply Advanced Oxidation Processes.

These results are of potential significance to radiobiology, radiotherapy, and industrial applications.

**Supported by:** NIH NCI R01CA045424, Research Excellence Fund and Center for Biomedical Research at Oakland University, The National Superconducting Cyclotron Laboratory at Michigan State University, NSF MRI award CHE-1920110.

# Oral Paper Presentation



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**OP-1**

**GREEN CHEMISTRY FOR DESIGNING  
A SUSTAINABLE FUTURE**

**Ankit**

Department of Chemistry, Hindu  
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**ABSTRACT**

Chemistry plays a pivotal role in determining the quality of modern life. The Chemical Industries and the other related industries supply us with a huge variety of essential products, from Plastics to Pharmaceuticals. However, these industries have potential to seriously damage our environment. Green Chemistry therefore serves to promote the design and efficient use of environmentally benign chemicals and chemical processes. Green Chemistry is expanding its wings from Academic Laboratories to Industrial units. It includes replacement of Volatile Organic solvents containing bulk of a reaction material, developing recyclable catalysts, developing energy efficient synthesis and encouraging the use of renewable starting material. Throughout a long time, Green Chemistry revealed how a basic scientific methodology and advanced practice can enhance the safe output to human life and the environment without compromising the desired outcomes. From the past lesson, currently the future chemists are being taught and trained to a wider concept of Green Chemistry to the practice and increased awareness towards human as well as Environmental impact. A need for great change in policy, rules and regulations which will force industry, research institute, academia, and other is highly demanding. This Paperwork presents some frontiers to be overcome in order to achieve balanced sustainability. A systematic chemical thinking is advocated, expanding the chemistry rationality from ontological and technological dimensions into the epistemological and ethical ones. This paper incorporates the role of Chemistry Education in promoting sustainability in a broad and systematic way. Moreover, the better is encouragements, awareness and make an individual person responsible to adapt to a Green Chemistry concept in a real practical way. Green Action always acts louder than Green Talks.

**Keywords:** Green Chemistry, Sustainability, Environment benign, challenges.

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**OP-2**

**AQUEOUS PHARMACEUTICAL  
SORPTION ON ENGINEERED BIOCHAR**

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**ABSTRACT**

Pharmaceuticals have cured deadly diseases and enhances life spans of human beings. But, in the past decades, pharmaceuticals have risen as a “contaminant of emerging concern” around the world. The persistence and resistance of pharmaceuticals leads to their accumulation in different water bodies. Inefficiency of conventional WWTPs to remove pharmaceuticals also contributed to their environmental presence. Thus, urgent need of sustainable and economically feasible remediation techniques has become evident. Present study describes the sorption of Acetaminophen (emerging contaminant) from aqueous systems with engineered biochar. The biochar was developed from rice husk biomass at 500 and 700 °C in an atmosphere-controlled muffle furnace. Further, biochar was impregnated with Mg/Al salts under same condition. The developed engineered biochar was characterized by using SEM, SEM-EDX, TEM, FTIR, and XRD. Engineered biochar was applied for aqueous pharmaceutical removal in batch mode through pH, isotherm and kinetic studies. The effect of pyrolysis temperature, pH, concentration, dose, contact time, and sorption temperature have been evaluated. Engineered biochar prepared at higher temperature shows significantly better removal of pharmaceutical as compared to engineered biochar prepared at 500 °C as well as pristine biochar. The synthesized engineered biochar provides better sorption and stability in aqueous system.

**Keywords:** Pharmaceuticals, Adsorption, Engineered Biochar.

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**OP-3**

**BRASSINOSTEROIDS AND SALT STRESS  
TOLERANCE IN PLANTS**

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**ABSTRACT**

Brassinosteroids (BS) constitute a class of steroidal plant hormones, which are implicated in diverse physiological and metabolic responses in plants. They also play an ameliorative role in plants under various abiotic and biotic stress conditions. In this study, the impact of one of the most stable BS analogues i.e. 28-homobrassinolide (HBL) on growth, nodulation and N fixation in chickpea was investigated. The seeds of chickpea (*Cicer arietinum*L.) cv. KPG-59 were treatment with sodiumchloride (NaCl) (1.0 or 10 mM)and/or HBL (10<sup>-8</sup> or 10<sup>-6</sup> M)for 8 hours each. The seeds were sown in earthen pots and the plants were allowed to grow under natural conditions in a net house. The plant samples were collected at 60 day stage to assess different parameters namely plant dry weight; number, fresh and dry weight of nodules; leghemoglobin content and nitrogenase activity of nodules; N and sugar content in nodules; nitrate reductase activity in leaves; GS, GOGAT and GDH activities in nodules and leaves, and seed yield (at harvest). The plants resulting from the seeds soaked in NaCl exhibited a reduction in these parameters proportionate to the concentration of the salt. HBL treatment, in absence of the salt stress boosted the parameters under consideration and also mitigated the inhibitory effect of NaCl, where the higher concentration (10<sup>-6</sup>) was more effective, both in presence and absence of stress. Moreover, seed yield was also increased upto 25% compared to the control, at harvest.

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**OP-4**

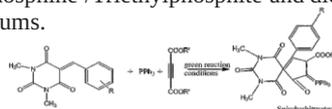
**GREEN SYNTHESIS AND BIOLOGICAL EVALUATION  
OF SPIRO BARBITURATES USING ZEBRA FISH MODEL  
FOR PHYSIOLOGICAL AND BEHAVIORAL ASSAYS**

**Devanshi Magoo, Prof Anju Srivastava  
Reena Jain and Yashna, Soma M. Ghorai, Padmashree  
Mudgal, Radhika Gupta and Shubham Yadav**

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Department of Zoology, Hindu College, University of Delhi, India  
Department of Biochemistry, Daulat Ram College, University of Delhi, India

**ABSTRACT**

Spiro barbiturates have held a position of prominence in Organic Synthesis due to the myriad of pharmacological activities they possess which make them attractive synthetic targets and promising drug candidates. These compounds have been extensively studied since their discovery for their antipsychotic, anti-HIV, anxiolytic, and anti proliferative properties. However, their preparatory methods employing the use of organic solvents have raised concerns owing to their hazardous and non-sustainable nature. Consequently, we shift our focus to greener alternatives which aim to reduce or eliminate typically used VOCs, making the synthesis sustainable and compliant with Green Chemistry guidelines. Our work has thus, been focused on developing a robust, efficient and sustainable protocol for which we have explored a tandem 3CR involving the condensation of various substituted benzaldehydes with 1,3-dimethyl barbituric acid followed by the subsequent reaction of the produced alkene with Triphenylphosphine /Triethylphosphite and diethyl acetylene dicarboxylate to give the desired product, in a variety of green solvents as reaction mediums.



Functionalised spirobarbiturate moieties were synthesised with minimal generation of hazardous chemical waste and their biological activity was evaluated using Zebrafish as the model system. The Zebrafish embryos were exposed to different spirobarbiturate compounds for 10 days to assess the toxicity at different concentrations and the Maximum non-lethal concentration was determined. The same concentration was used to perform physiological (Spontaneous movement and heart rate assay) and behavioural assays (thigmotaxis and scototaxis) on the Zebrafish embryos to develop an overall understanding of the said compounds in contrast with the control environment.

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OP-5

**PLANT GROWTH, PHYSIOLOGICAL  
PROPERTIES AND YIELD OF GINGER (ZINGIBER  
OFFICINALE) AS INFLUENCED BY PLANT  
GROWTH-PROMOTING BACTERIA**

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**ABSTRACT**

Plant growth promoting bacteria (PGPB) promote plant growth and yield by producing phytohormone which increases the growth, yield and physiological traits of the host plant. A net house experiment was carried out at Institute of Genetics and Plant Experimental Biology, Uzbekistan Academy of Sciences, Kibray, Uzbekistan. In this study, the role of plant-growth promoting bacteria on plant growth, physiological properties and yield of ginger (*Zingiber officinale*) was investigated. The pot experiment was a completely randomized block design with five replications. Five PGPB strains (*B. subtilis* IGPEB 1, *B. pumilis* IGPEB 2, *B. altitudinis* IGPEB 8, *B. koreensis* IGPEB 17 and *B. endophyticus* IGPEB 33) were used in the experiment.

The results showed that plant-growth-promoting *B. Subtilis* IGPEB1, *B. koreensis* IGPEB 17 and *B. endophyticus* IGPEB33 significantly increased the plant height, leaf number, leaf length and leaf width as compared to the control treatment. Moreover, inoculation of *B. endophyticus* IGPEB33 treatment significantly enhanced the relative water content, chlorophyll a, chlorophyll b, total chlorophyll and carotenoid contents. Compared to the control, inoculation *B. endophyticus* IGPEB 33 treatment significantly enhanced the fresh yield and dry yield in ginger. The results concluded that *B. Subtilis* IGPEB1, *B. koreensis* IGPEB 17 and *B. endophyticus* IGPEB33 strains positively influence plant growth, physiological traits and yield in ginger.

**Keywords:** Ginger; plant growth, total chlorophyll content, relative water content, yield.

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**OP-6**

**ISOLATION AND MOLECULAR CHARACTERIZATION  
OF BACTERIA FROM E-WASTE BURNING SITES IN  
MORADABAD, INDIA**

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**ABSTRACT**

Electronic waste or E-waste refers is the discarded electrical and electronic devices which are disposed into soil without being processed. Burning of the E-waste leads to the release of the harmful and toxic metals like lead, chromium, cadmium, mercury, arsenic, and barium These heavy metals present in many electronic goods gets accumulated in the soil and leaches into the surrounding environment and causes adverse health effects. Microbes plays an important role in the degradation of heavy metal contaminated soil. In the present study bacteria were isolated and identified using 16S rRNA markers from the soil samples collected from different E-waste contaminated sites of Moradabad district of Uttar Pradesh. Based on the Morphological, biochemical and Molecular characterization the microorganisms were identified as *Pseudomonas putida*, *Bacillus subtilis* and *Bacillus licheniformis*.

The microorganisms like bacteria, fungi, yeast and algae reduce toxic metal ions to non-toxic state either by adsorbing onto the cell surface or accumulate and complex inside the cell. This study shows possibilities for development of eco-friendly and effective technologies for the removal of heavy metals from metal contaminated areas using this bacterial strain.

**Keywords:** E-waste; characterization; 16SrRNA gene sequencing; Moradabad.

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**OP-7**

**THERMOPHILIC ALGAE: APROMISING  
APPROACH TO GREEN ENVIRONMENT**

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**ABSTRACT**

The presence of microorganisms at every possible habitat on the earth has always been the center of attention to find the potential candidates beneficial to the humankind. Thermophilic algae are found in the hot springs with extreme environmental conditions of temperature ( $>50$  °C), light, pH and nutrient composition. Many thermophilic algal species have been found to be helpful in attaining sustainable environment. Species like *Cyanidium caldarium*, *Galdieriasulphuraria*, *Mastigocladuslaminosus*, *Thermosynechococcus* and *Synechococcus* have been found to have more thermostable enzymes. Some members of *Thermosynechococcus*, *Synechococcus* and *Mastigocladus* possess CRISPR-Cas systems in their genome which can be exploited in various genetic engineering tools. Their ability to grow too fast and tolerate harsh conditions of high temperature, light and pH makes them very promising candidates for CO<sub>2</sub> sequestration. These characteristics gives the prospective to utilize them in the sector of nutraceuticals, cosmeceuticals, pharmaceuticals, agricultural and fuel industries along with the approach to combat global warming and climate change problems and helps to attain sustainable environment. In this paper, we discuss the cultivation and harvesting techniques of thermophilic algae. Their applications in terms of fuel (biodiesel) and nonfuel (pigments, thermostable enzymes, nitrogen fixation, wastewater treatment, removal of dyes, and heavy metals from industrial effluents, biofertilizer etc) are discussed. Their CO<sub>2</sub> sequestration and nitrogen fixation potential have also been highlighted. Their recent finding of CRISPR-Cas as a genetic tool, challenges and future prospects are also elaborated.

**Keywords:** Thermophilic algae, CO<sub>2</sub> sequestration, Sustainable environment, Hot springs, Thermophilic algae applications.

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OP-8

**ANTIBACTERIAL PROPERTY OF  
ENDOPHYTIC FUNGUS- ASPERGILLUS ORYZAE**

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**ABSTRACT**

Endophytes are microorganisms that colonize the tissues of live host plants usually showing no apparent symptoms. These endophytes, both bacteria and fungus, can produce a variety of secondary metabolites having a wide range of essential properties. Thus, they can be used for various medicinal, environmental and agronomic purposes. Six species of Endophytic fungi (AL1R1 to AL1R6) were isolated from root of *Argemone mexicana*, a medicinal plant. Medicinal plant samples were collected from Amlighat, Assam in February, 2019 at flowering stage. Genomic DNA was extracted using CTAB (Cetyl trimethyl ammonium bromide) buffer. The total genomic DNA concentration was estimated by absorbance at 260 nm in nanodrop spectrophotometer. PCR standardization was carried out using Internal transcribed spacer primers – ITS1F (5'-TCCGTAGGTGAACCTGCGG) and ITS-4 (5'-TCCTCCGCTTATTGATATGC) for endophytic fungi. The amplified genes were sequenced by a commercial company Eurofins Genomics India Pvt. Ltd, Bengaluru, India. The obtained sequence data were aligned by using the BLAST software (<http://blast.ncbi.nlm.nih.gov>) algorithm at NCBI. Endophytic fungi were as *Aspergillus* sp., *Alternaria* sp., *Chaetomium* sp., *Talaromyces* sp., and *Cladosporium* sp. Antibacterial properties of endophytic fungi were checked against waterborne pathogens, *Escherichia coli*, *Vibrio cholerae* and *Salmonella typhimurium*. *Aspergillus oryzae* showed antimicrobial

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OP-9

**PHYSIOCHEMICAL ASSESSMENT OF  
OKHLA LANDFILL LEACHATE, SOUTH DELHI**

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**ABSTRACT**

Landfilling is very easy and cost effective way of waste disposal. This method was traditional and practiced in most of countries but still prefer in many developed and developing countries. Present attempt was made on highlighted Physiochemical analysis of leachate samples of Okhla landfill which is located in South Delhi just adjacent to ESIC hospital at Tughlagabad. For this study sampling and analysis was done for three month i.e March, April and June 2021 in laboratory for various physiochemical parameters like Chemical Oxygen Demand, Biological Oxygen Demand, Ammonical Nitrogen, Total Kjeldahl Nitrogen, Phosphate, Hydrogen sulphite, Chloride, Total dissolve solid, Total suspended solid. Result were found that analysed result of leachate samples were pH 7.76, Electrical Conductivity 48183.33mg/l, Chemical Oxygen Demand 16166.67mg/l, Biological Oxygen Demand 6666.66mg/l, Ammonical Nitrogen 3116.66mg/l, Total Kjeldahl Nitrogen 2045.5mg/l, Phosphate 200mg/l, Total Dissolved Solid 31517mg/l, Total Suspended Solid 9420 mg/l, Chloride 3306.66, Hydrngen Sulphite 74 mg/l, Sulphate 1131.66mg/l. It has been compared with leachate standard set by MOEFCC as in Solid Waste Management Rule 2016 and found all the concentration of analysed samples were found beyond the standard and need to be minimize the concentration of leachate by adopt various ecofriendly treatment method. Presently most important issue was that there are no leachate collection facilities or gas trapping facilities and consequences of which lead to environmental degradation and there is urgent need of waste minimization and leachate collection facilities and treatment of leachate.

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OP-10

**ALLEVIATION OF IMMUNOTOXIC EFFECTS OF  
POLY AROMATIC HYDROCARBONS NAPHTHALENE  
AND ANTHRACENE BY MICRONUTRIENTS**

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**ABSTRACT**

The absolute dependency of an effective immune response on micronutrient availability has been an active area of research in the recent years. The links between micronutrient deficiency and immune impairment are very well understood and demonstrated in the recent COVID 19 pandemic outbreak. Adequate intake of micronutrients is required for the immune system to launch an effective antigen recognition and response. Micronutrient deficiency suppresses immunity leading to dysregulation of the balanced host response. The immune system can be adversely affected by drugs and chemicals, collectively referred to xenobiotics.

Polycyclic aromatic hydrocarbons (PAHs) represent an important class of environmental pollutants that are highly toxic, carcinogenic, mutagenic and are potent immunosuppressants. PAHs are commonly detected in air, soil and water and are hence ubiquitous in the environment making human exposure to these compounds as inevitable. Adverse effects of PAHs have been documented on human system development, humoral immunity and on host resistance. In the current study the potential of four dietary micronutrients Vitamin A, Vitamin C, Folic acid and Zinc was investigated for their efficacy to counteract the immunotoxic effects of poly aromatic hydrocarbons naphthalene and anthracene. Study was conducted on peripheral blood lymphocytes as model systems and cell based in vitro assays like MTT assay, LDH leakage assay, ROS generation by DCFDA analysis, measurement of mitochondrial membrane potential by Rhodamine B assay were conducted to understand the protective effects of micronutrients on the immune system. Further, measurement of mitotic index on onion root tips was conducted to understand the effects of the PAHs on cell proliferation. Results of the study indicated that PAHs anthracene and naphthalene induced significant immunotoxicity as evidenced by decreased cell growth, cytotoxicity, increased generation of ROS and altered mitochondrial membrane permeability implicating the adverse influence of PAHs on the immune system. Pretreatment with micronutrients provided protection as indicated by the mitigation of the immunotoxic effects induced by PAH. Vitamin A was found to confer the best protective effects, followed by Vitamin C, zinc and the least protective effects were observed with folic acid. Results implicate that nutritional supplementation with Vitamin A could be a diet based strategy to prevent immunotoxicity by PAHs especially in small children and adults who are at risk of exposure to these compounds by occupational hazards.

Keywords: PAH, Micronutrients, Anthracene, Naphthalene, Vitamin A, Vitamin C, Zinc, Folic acid.

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OP-11

**BACTERIAL DEGRADATION OF SELECTED  
AZO DYES IN TEXTILE EFFLUENT ADAPTED  
NATIVE STRAINS**

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**ABSTRACT**

The continuous boom of population and increasing industrial activities in the specific sectors, viz., textiles, leather, plastics, cosmetics and food processing industries require the development of various natures of novel dyes. The textile industry is one of the major contributors of azo dye pollutants and discharges the large quantity of azo dye effluents, which causes an acute hazardous effect on environment and human health. A tough venture to sustainable dye treatment approaches distinctly wants to ameliorate their effect on the environment. The present study investigated the azo dye degradation efficiency of adapted *Pseudomonas* sp. and *Bacillus* sp. from textile effluent and contaminated sludge in optimized culture conditions. The adapted bacteria strain were identified by morphological and biochemical characteristics *Pseudomonas* isolate (TEPI-1) and *Bacillus* isolate (TEBI-1) were tested individually for the decolorizing of malachite green and crystal violet dyes under optimized conditions of pH, temperature and dye concentration minimum to maximum (10mg/l to 500mg/l) on decolourization were studied. TEPI-1 exhibited maximum decolourization with Malachite green 84% and crystal violet 94% in 10 ppm concentration at pH 7, temperature 37°C after 72h of incubation. TEBI-1 exhibited maximum decolourization with Malachite green 93% and crystal violet 90% in 10 ppm concentration at pH 7, temperature 37°C after 48h of incubation. Our preliminary result indicates the dye degrading properties of *Pseudomonas* and *Bacillus* isolated from Textile water collected from Bhadohi, Uttar Pradesh, India.

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OP-12

**EFFECT OF SUSTAINABLE BIOCHARS  
ON GROWTH AND DEVELOPMENT OF  
PLANT GROWN IN SALINE SOIL**

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**ABSTRACT**

Soil salinity is a problem of global concern affecting majority of agricultural nations in the world. In fact, it is the second largest cause of soil degradation. It has spread to 7.6% of the global land area and 75% of the total cultivated land area and has become a great threat to food security. As such, looking for a sustainable way to remediate this problem is extremely important. Chemical and organic amendment methods are available, but these are not sustainable options for long term use. Biochar, a solid carbonaceous material, has been proposed as a more viable option in recent times. In this study, biochars derived from some of the most common agricultural waste biomass (wheat straw and rice husk), are used as soil amendment to alleviate salt stress in sampled agricultural soils. The biochar used in this study is prepared using an indigenously designed farmer friendly bioreactor, which provides an added advantage for future field applications. The positive results (increased plant height, leaf area, fruit weight, soil nutrients) shown in this study indicate how biochar serves as an attractive sustainable option for remediation of salt stress in agricultural soils.

**Keywords:** Salt stress, agricultural waste biomass, biochar, indigenous bioreactor.

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# Poster Presentation





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PP-1

**COBALT NANOPARTICLES BASED CARBON  
ELECTRODE FOR DETECTION OF RESIDUAL  
NITRITE IN THE SOIL OF AGRICULTURAL FIELDS**

**Aastha Puspalak<sup>1</sup>, Preetha Chinnadurai<sup>1</sup>  
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**ABSTRACT**

In the past few decades, rapid increase in population has led to over-utilisation of nitrogen-based fertilizers to increase crop yield. But accumulation of excess fertiliser in soil ultimately leads to deterioration of soil quality with carcinogenic effects on animals and humans. The conventional spectroscopic methods available for nitrite detection, even though good, are suitable for higher concentration detection. Hence, a fast effective and reliable method of nitrite detection is necessary. Cobalt oxide nanoparticles-based carbon electrodes have excellent sensitivity towards electrocatalytic detection of nitrite ions.

In this research, Cobalt Oxide nano particles were synthesized by precipitation and calcination of Cobalt Oxide. The EDAX analysis confirms the presence of Co and O. The absorption at 506 cm<sup>-1</sup> which corresponds to Co-O in FTIR confirms the formation of cobalt oxide. The XRD confirmed crystallinity and TEM images show average particle size of 30 nm. The SEM image taken reveals that the material is in the form of flakes. A carbon-based electrode was developed using Cobalt Oxide, Graphite and Silicon oil. Cyclic voltametric studies for the detection of nitrite were carried out in nitrite concentration range (0 mM to 10 mM), potential range of -1.0 V to 1.2 V using phosphate buffer at pH=7, in ambient conditions. The electrode showed good sensitivity towards detection of nitrite with LOD of 0.3 µM. Due to low-cost preparation, sensitivity towards NO<sub>2</sub><sup>-</sup> ions and high conductivity, the sensor can be employed for detection of nitrite in agricultural field soil samples.

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**PP-2**

**MORINGA OLEIFERA-MEDIATED  
BIOSYNTHESIS OF METALLIC NANOPARTICLES  
AND ITS APPLICATIONS: A REVIEW**

**Amit Bhardwaj and Arun K. Singh\***

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**ABSTRACT**

The phytochemicals present in the various parts of plant are useful for synthesis metallic nanoparticles because of its special ability to act as reducing, stabilizing as well as and capping agents. In the recent years, several attempts were made for the green synthesis of stable metallic nanoparticles of various metals by the use of aqueous extract of Moringa oleifera. Moringa oleifera is a medicinal plant of Moringaceae family and commonly known as drumstick tree. Researchers reported the various nanoparticle synthesis by the use aqueous extract this plant without using any organic solvents and evaluated their efficacy for various applications as antimicrobial activity and photocatalytic agents. This review summarizes the information on significant chemical constituents of Moringa oleifera plant extracts and their utility in synthesis of various metallic nanoparticles which are highly needful in several scientific domains.

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PP-3

**DISTRIBUTION PATTERN AND  
ETHNOMEDICINAL USES OF ANGELICA  
GLAUCA AN ENDANGERED MEDICINAL  
PLANT OF NORTHWESTERN HIMALAYA**

**Anjali Mehta, Sarla Shashni\*  
Vinod Kumar and Twinkle Thakur**

G.B. Pant National Institute of Himalayan Environment  
Himachal Regional Centre, Mohal, Kullu- 175126, Himachal Pradesh, India

**ABSTRACT**

Angelica glauca (Apiaceae) is one of the most important multipurpose plants growing naturally between the altitude of 2200 to 2600 m above sea level in cold and arid environment of Kullu district, Himachal Pradesh. The present study involves the population assessment of the species in different regions of Kullu district and its ethnomedicinal uses by local inhabitants. Study revealed that the aromatic roots of the species are traditionally used as spices and herbal medicine. It is also reported that the species is used for treatment of various diseases/ailments such as vomiting, indigestion, influenza, dysentery, stomach pain, asthma, loss of appetite, post-delivery weakness, etc. It is also used for livestock's against diarrhea, consumption and also used as fodder to increase lactation in cattle's. It has been also observed that due to unsustainable over harvesting, lack of awareness and cultivation techniques of the species its population in natural habitat is depleting fast. Therefore, it is suggested to conserve the species in its natural habitat and cultivation in farmer fields for the species conservation and economic benefit to the locals.

**Keywords:** Angelica glauca, endangered, ethnomedicinal, spices, conservation.

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PP-4

**Antibacterial Property of Azadirachta Indica  
Leaves against Vibrio Cholera Without Harming  
the Gut Microbiome**

**Ankita Saxena<sup>1</sup>, Asish Kumar  
Mukhopadhyay<sup>2</sup>, Shoma Paul Nandi<sup>3\*</sup>**

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**ABSTRACT**

Azadirachta indica (A. indica) or Neem has its role in promoting health and is said to be rich source of antioxidants, besides having antibacterial activity. A. indica has been a part of both ancient and modern medicine due to its therapeutic role. Present study aims to highlight antibacterial activity of the leaves of A. indica on water-borne disease causing bacteria Vibrio cholerae (V. cholerae). The ethanol extract of A. indica leaves was tested against V. cholerae and probiotics such as Lacobacillus acidophilus (L. acidophilus), Propionibacteria freudenreichii (P. freudenreichii), and Bifidobacterium BB-12. The agar cup bioassay results showed V. cholerae gave a zone of inhibition (ZOI) of 23 mm, while L. acidophilus, P. freudenreichii, and Bifidobacterium BB-12 showed no ZOI. This indicates the reason behind immense popularity of A. indica in herbal medication. Thin Layer Chromatography (TLC) showed distinctive spots when loaded with ethanol extract of A. indica leaves and run in Toulene: Chloroform: Acetone (40:25:35) solvent system. Contact bioautography results showed a ZOI of 20 mm. TLC eluted bioactive spots showed a ZOI of 18 mm for spot 1 when tested against V. cholerae. HPLC and GCMS results identified the compound causing antibacterial activity in ethanol extract of A. indica leaves. Almost no ZOI against probiotics show that leaves of A. indica cause no harm to the gut microbiota. Therefore, it can be rightly said that A. indica leaves can play a vital role in preparation of herbal therapy to combat water borne diseases and also keep the gut microbiome intact.

**Keywords:** Azadirachta indica, Vibrio cholerae, probiotics, herbal therapy, gut microbiome.

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**PP-5**

**NOISE POLLUTION AND HUMAN BEHAVIOR**

**Ashutosh Kumar**

Research Scholar  
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**ABSTRACT**

The natural environment consists three major component as soil, air and water that affecting most to the human beings. But recently due to increasing development in life style, environment has also affected by noise pollution. Human behavior is greatly affected by the environment. Environmental Psychology is a new branch of psychology that focuses on relationship between the physical environment and human behavior and well-being. The environmental factors like noise, heat, air-pollution and other irritants affect the human life.

A short psychological study is conducted on the effect of noise-pollution on young behavior of two groups mainly of Urban and Rural. This research study is taken from the environmental psychology. In this study, noise and mass media are taken as the main source.

The objective of the present study is to show that the imbalance of Psychological and Biological Environment affects the physical and mental health of young in urban and rural area of Bihar. It is also tried to see comparatively which group is more affected and what effect is seen on them.

Two groups each of 30 young ranged in age-group of 30-35 were taken from urban and rural areas for comparative analysis in this study due to reason behind as the great variation of noise pollution. The main sources for the study were noise and mass-media. The groups were selected through random sampling technique. Data collection was done by observation and interview method. The responses of the subjects in the use of mass-media were taken in the form of percentage. Various mass-media taken into account were T.V., computer, video-game, mobile, reading-books. The study shows that mass-media is used more frequently by urban young than the rural one and in order to study the effect of noise-pollution due to mass media, on young's behavior, a mental health scale was used. It was found that the analysis of the data collected gave result that extensive use of mass-media put a negative effect on the physical and mental health in the form of noise-pollution. Effect of noise-pollution is found more on urban boys. It decreases the working-capacity and increases pressure and frustration. Certain psychological effects such as irritation, sleep-disorder, distract-attention, lack of concentration, mood-disorders, etc were seen. These psychological conditions give rise to various mental disorders. So, it is suggested through this study that noise pollution should be managed and control at family, society and community level.

**Keywords:** Noise pollution, urban/ rural youngs, human behavior, environmental psychology, mental health, mental

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**PP-6**

**HUMIC SUBSTANCES AND THEIR  
AGRO-ENVIRONMENTAL APPLICATIONS**

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**ABSTRACT**

Humic Substances (HS) are composite mixtures of natural organic compounds that are present everywhere in the nature from soils to sediments and natural water. These substances consists of wide variety of natural organic compounds that are derived from dead biological matter like decomposed plant tissues and their microbial activities. Various environmental and ecological processes are regulated by HS .In general, they support the development of plants and terrestrial life and restrict the outcome of environmental pollutants by substituting as sorbents for organic contaminants, radio nuclides and toxic metal ions. They are the reservoirs for large amount of Earth's organic materials like carbon and many more. Due to their roles in land management strategies aimed at promoting carbon sequestration, this field of study has gained the much needed attention in recent years. The characterization of HS can be challenging due to it's complex and heterogenous structure. The best tool for interpreting the structure of HS is solid state nuclear magnetic resonance (NMR). Morphogenic investigation includes induction of root hair initiation and lateral root formation in whole plants and stimulate the development of shoot and root in treated cell calluses. HS boost efficacy of nutrients by supporting the assimilation of both micro and macro elements and increase plant growth by introducing nitrogen, carbon and secondary metabolism. Value Added Products formed by HS like compost and these products are used for eco-friendly agricultural practices.

**Keywords:** Humic Substances (HS), Soil, Value Added Product, Eco-friendly, Plant Growth.

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PP-7

**PHYTOREMEDIATION  
THROUGH FUNGAL ENDOPHYTES**

**Deevanshu Chutani<sup>1</sup>, Pooja Singh<sup>2</sup> and Shoma Paul Nandi<sup>3\*</sup>**

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**ABSTRACT**

Organic and inorganic chemicals used in industrial and agricultural activities are often responsible for soil and groundwater toxicity. Presence of pollutants in soil and groundwater leads to a sharp decline in fertility of the environment which results in severe disruptions to the ecosystem. Toxins present in soil not only affect the yield of a plant but also lead to bioaccumulation of harmful compounds into the plant which when consumed by humans and animals will cause biomagnification and have devastating effects on their health. For many years, polluted soil has been dealt with by the addition of more chemicals and artificial fertilizers to the soil, but this approach is no longer sustainable. Endophytic phytoremediation, however, solves this problem without any negative effects on the ecosystem. Endophytes are microbes that colonize internal tissues and exhibit a mutualistic co-existence pattern with a host plant, a relationship by which both the organism's benefit, the plant provides nutrition to the endophyte and in exchange, the host-specific endophyte helps in promoting plant growth, metabolism, favors production of secondary metabolites and regulates signaling pathways in the plant. Fungal endophytes offer a sustainable solution for the removal of pollutants from soil and groundwater, they provide a multi-disciplinary approach and are economically viable. In this review, we will discuss about benefits of endophytic fungi not only to the host plant but to the whole ecosystem.

**Keywords:** Endophytes, Phytoremediation, Plant growth, Groundwater toxicity, Soil fertility, Bio accumulation.

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**PP-8**

**ROLE OF ENDOPHYTES IN PLASTIC DEGRADATION**

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<sup>1,2,3</sup>Amity Institute of Biotechnology  
Amity University, Noida, Uttar Pradesh

**ABSTRACT**

Endophytes refers to an endosymbiotic intracellular/ intracellular association between a microbe (bacteria and fungi) and plants without exhibiting any pathogenic consequences on the host plant. The diverse and unique biological niche of the endophytes throws a light on the wider applications of their metabolic capabilities. Global development has resulted in enormous boom and rapid accumulation of plastic raising ecological and economic concerns. Plastic production and consumption has increased several folds over recent years, resulting in almost 359 million metric tones production. This sheer volume of plastic has spring up the number of research being conducted to eradicate this synthetic waste. However, the current rate and methods of plastic waste disposal have low efficiency and do not match with the enormous rate of production. Continual exposure to plastic during both manufacturing and consumption have led to adverse health issues such as cancer, endocrine disruption, asthma, infertility. By attaining the knowledge regarding the process of polymer degradation, several adequate alternatives can be developed. One such alternative to degrade plastic via biochemical mechanism is bioremediation using endophytes. Several studies have been conducted which has proven the high potency of endophytes. Polyester polyurethane was successfully degraded in both solid and liquid suspensions by serine hydrolase enzymatic action of *Pestalotiopsis microspora* in aerobic and anaerobic conditions. Polyvinyl alcohol was also degraded by *Penicillium brevicompactum*. However, this field is in its infancy, extensive research on biological and chemical diversity of endophytes as well as polymer degradation is needed to successfully eradicate plastic waste.

**Keywords:** Endophytes, Bioremediation, Plastic waste, Plastic degradation, Biochemical mechanism.

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PP-9

**A BROAD VIEW OF ARSENIC CONTAMINATED  
SOIL, WATER AND RICE SYSTEM IN SELECTED  
AREAS OF BALLIA DISTRICT (UP), INDIA: AN  
INVESTIGATION BASED ON PHYSIOCHEMICAL  
NUTRIENT AND METABOLIC ANALYSIS**

**Himanshu Saini Medha Panthri and Meetu Gupta\***

Ecotoxicogenomics Lab, Department of  
Biotechnology, Jamia Millia Islamia, New Delhi-25, India.

**ABSTRACT**

Assessment of soil/groundwater and rice genotypes for arsenic (As) and other nutrients along with metabolite profiling has not been carried previously in Ballia district of eastern UP, India. Therefore, utmost attention is needed towards its accumulation behavior in soil-water-rice system of the district. Three sites namely, Sohaon, Reoti and Haldi were selected from where soil, water and rice genotypes were procured to carry out the analysis of their physiochemical parameters, and As/other metal profiling. Selected rice genotypes were also subjected to metabolites estimation. Presented data revealed that Sohaon region was best among three due to optimum pH and low TDS of water, high organic carbon and NPK in soil. However, As content in both water and soil exceeded permissible limit, and were in order: Sohaon>Haldi>Reoti. In addition to As, we also report exceeding concentrations of Zn, Fe and Cu in water and soil samples. While, rice genotypes- Pioneer from Haldi, and Mini mansoori from Sohaon exhibited maximum and minimum As content, respectively. Here, we novelly report that among all studied metabolites: amino acids - glutamic acid, phenylalanine, proline, aspartate; phenolics –trans-Ferulic acid, p-Coumaric acid, syringic acid; and flavonoids – kampeferol, rutin hydrate, naringenin, epigallocatechin, apigenin were responsible to overshadow As stress in rice genotypes, particularly in Mini mansoori and Pioneer. Our PCA analysis also grouped these two rice genotypes together with aspartic acid being the main responsible variable. Based on our observations, we suggest that metabolite profiling can be used as biomarker to screen out tolerant and sensitive genotypes which would help in selection of better varieties to grow in As contaminated regions. Further studies of these metabolites in future will reveal more about their role in As stress mitigation. Also, such studies may provide site specific environment management strategies related to food security and environment safety.

**Keywords:** Accumulation, Amino acids, Flavonoids, Nutrients, Phenolics.

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PP-10

**SURFACTANT POLLUTION IN ABIOTIC  
& BIOTIC COMPONENTS OF THE ENVIRONMENT  
& ITS BACTERIAL DEGRADATION**

**Jayati Arora<sup>1</sup>, Anuj Ranjan<sup>2,3\*</sup>, Abhishek  
Chauhan<sup>2</sup>, Rima Biswas<sup>4</sup>, Tanu Jindal<sup>2</sup>**

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**ABSTRACT**

Overuse of surfactants and their discharge into the environment with laundry water has been identified as the major reasons for increased foaming of the water bodies, causing physiochemical changes in the soil characteristics and adversely affecting terrestrial as well as aquatic life. Several species of microorganisms have been identified for the bioremediation of surfactants. Pseudomonas sp. has been reported to biodegrade the linear alkyl benzene sulphonates (LAS), sodium dodecyl sulphates (SDS), and alcohol ethoxysulphates (AES). Other species like Bacillus, Klebsiella oxytoca, Delftiaacidovorans, etc. have also shown effective degradation of potential. Degradation efficiency as high as 96.8% has been reported in other surfactant types like cationic, non-ionic, and amphoteric. Genetic and enzymatic pathways and identification of gene clusters responsible for the degradation of surfactants are also being studied.

The current study illustrates the effects caused by surfactant pollution on the abiotic and biotic environments, the current status of surfactant biodegradation, lists the potential bacterial strains, their mechanism of degradation, genes, and enzymatic pathways. It also talks of the need of optimal conditions required for surfactant degradation in the natural environment.

**Keywords:** anionic surfactants, bioremediation, microbial consortia, genes, enzymes.

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PP-11

**FLUORINE-FREE COATED SURFACES  
WITH SPECIAL WETTING BEHAVIOUR  
USING POLYDIMETHYLSILOXANE AND  
ITS APPLICATION: A REVIEW**

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**ABSTRACT**

In last decade, nanostructured coated surfaces with special wetting behavior such as hydrophobic and superhydrophobic have gained remarkable attention for various applications like oil/water separation, self-cleaning, anti-corrosion and anti-icing applications. In general for the fabrication of surfaces with hydrophobic and superhydrophobic behavior two things are highly essential: (1) Low surface energy, (2) high roughness. Thus, in order to provide low surface energy, organic compound based on fluorinated hydrocarbon are widely used. However, in view of environmental protection, the utilization of fluorinated compounds is harmful to environment because of its significant toxicity, bioaccumulative and persistent nature. Therefore, in order to construct fluorine free coating, polydimethylsiloxane (PDMS) has been explored widely on various surfaces because of its several specific properties like that low-surface energy, eco-friendly, strong adhesion on versatile surfaces, long term thermal and chemical durability, rapid and facile coating formation ability. Therefore in this review, we summarized fabrication of PDMS-based fluorine-free coatings with special wetting properties on various materials and its applications.

**Keywords:** Fluorine-free coatings, Polydimethylsiloxane, special wettability, superhydrophobic, engineered coatings.

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PP-12

**STUDY ON COMMUNITY DYNAMICS  
AND NICHE BREADTH OF AQUATIC  
GASTROPODS IN FLOOD PLAIN WETLAND**

**Manoj Kumar Pandey<sup>1</sup> and Rakhi Kumari<sup>2</sup>**

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**ABSTRACT**

The analysis of community dynamics depends in part on the measurement of how organisms utilize their environment. One way to do this is to measure the niche parameters of a population and to compare the niche of one population with that of another. Since resource is one of the most important dimensions of the niche, the analysis of animal resource utilization and nature of competition to the others that is either physical environment or biological population is closely related to the problem of niche specifications. Hence keeping this above mentioned view in mind, the current research paper dealt with the measurement of niche breadth of gastropods in a lentic water body. Gastropods constituted the major share of molluscan fauna in lentic environment. The highest niche breadth of gastropod was observed in March, 2019 (1968 indiv/m<sup>2</sup>) and October, 2019 (2704 indiv/m<sup>2</sup>) while the lowest niche breadth in July, 2019 (192 indiv/m<sup>2</sup>) and August, 2020 (149 indiv/m<sup>2</sup>) during both the annual cycles respectively. Generally, they showed their maximum niche breadth during the post winter and early summer months. *Digoniostomapulchella* was the most dominant among the gastropod population, if population started gradually raising from October, 2018 onwards and reached its peaks during January, 2019 (887 indiv/m<sup>2</sup>) followed by a gradual decrease in the following months. The minimum niche breadth (21 indiv/m<sup>2</sup>) was recorded in August, 2019 during the first annual cycle, whereas the highest niche breadth (2467 indiv/m<sup>2</sup>) in October, 2019 and lowest in September, 2020 (21 indiv/m<sup>2</sup>) during the second year. *Digoniostomapulchella* showed their maximum niche breadth during the winter months in the first annual cycle and during post monsoon and summer months in the second annual cycle. The second most dominant species that showed the highest niche breadth was the *Viripara bengalensis*.

**Keywords:** community dynamics, niche breadth *Digoniostomapulchella*, *Viripara bengalensis*. etc.

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**PP-13**

**SCOPE AND POTENTIAL OF CLIMATE  
SMART TECHNOLOGY FOR SUSTAINABLE  
INDIAN CITIES**

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**ABSTRACT**

India's urban population, which currently stands at 377 million people, is forecast to rise by 404 million by 2050 . Food production, water supply, coastal settlements, forest ecosystems, health, and energy security are likely to be impacted by various projected Climate Change scenarios. The most efficient strategy to combat Climate Change is to switch to environmentally sustainable technologies and promote energy efficiency through renewable energy, forest protection and water conservation, among other things. This research aims to study the different smart technologies that could help to mitigate the effects of Climate Change in Indian cities and its importance. The research also highlights the Investment Potential in different sectors such as agriculture, waste treatment, transport etc, to adopt such technologies to achieve a sustainable living of the urban population.

**Keywords:** Climate Smart Technology , Sustainable cities , Climate Change Mitigation.

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**PP-14**

**STUDY MONTHLY FLUCTUATIONS  
IN THE PHYSICO-CHEMICAL PROPERTIES  
OF THE GANGA RIVER AT HAJIPUR, BIHAR**

**Poonam Kumari**

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**ABSTRACT**

The maintenance of a healthy aquatic system depends on the physico-chemical properties of water. The present study is an attempt to measure water quality of Ganga River, Hajipur, Bihar. Physico-chemical status were conducted during 2018-2020 in three different sites i e. Konahara ghat(x), Mukhtidham ghat(y) and Terharsiya ghat(z), Hajipur, Bihar.

Water temperature was varied between 17.1 °c( January 2019, site x) to 29.8°C (July 2019, site z). The pH value varies from 6.8 (June 2019, y and may 2020 y) to 7.8( December 2019 z and December 2020 z). The TDS value observed 120 mg/l (February 2020, z) to 158 mg/l (September 2019, x). Water is more turbid during rainy season, the turbidity value ranged from 54( January 2019 y) to 89 (August 2019, z). The water is slightly acid in rainy season. It is very rich in conductivity that value ranged from 368 microseconds/cm ( January 2019, x) to 260 microseconds/cm (June 2019, x). In dissolve oxygen content that value ranged from 4.6 ( September 2020,z ) and 7.8 ( December 2019, y).

**Keywords:** Ganga River, Physico-Chemical & January Etc.

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PP-15

**IMPACT OF MULTI-NUTRIENT SEED  
PRIMING APPROACH IN ARSENIC STRESSED  
RICE (ORYZA SATIVA L.) GENOTYPE**

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**ABSTRACT**

Adaptation of plants to the environment are always challenged under stress. Any kind of biotic and abiotic stress affects nutrient quality and its availability inside the plant, ultimately affecting human health and causing malnutrition. Among toxic metalloids, arsenic (As) contamination poses a major health hazard to human through its carcinogenic toxicity. Major contributor to dietary As exposure is rice. Therefore, reducing its accumulation and maintaining nutrient homeostasis in crop plants are imperative to ensure food safety. The objective of the present investigation was to consider the effectiveness of multi-nutrient seed priming with iron (Fe) supplementation in reviving As induced alteration on pigment content, photosynthetic parameters, sugar/ starch metabolism, and retrieving nutrient deficiency by modifying nutrient use efficiency at young stage. Experiments were conducted on 15 days pot grown plants under 150µM of As in combination with priming treatment and Fe supplementation. Arsenic exposure led to decline in chlorophyll content, photosynthetic parameters and starch content. However, an increase was observed in activity of starch degrading enzymes and total sugar content. Decrease in status of macro and micro nutrient content was also noteworthy in As- stressed rice seedlings. Conversely, priming treatment and Fe supplementation brought about considerable alteration in all parameters examined in As treated seedlings. Priming treatment and Fe supplementation ameliorated As toxicity by reducing its accumulation and enhancing uptake and transport of essential nutrients. Markable increase in pigment concentration, photosynthetic parameters, Fe-related enzymes and nutrient status of plant demonstrated protective role of treatment in presence of As. This study highlights the potentiality of seed priming and Fe supplementation in fortifying the As stressed crop plants with essential nutrients.

**Keywords:** Multi-nutrient priming, Arsenic, Rice, Fortification, Iron.

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**PP-16**

**ENDOPHYTIC PHYTO  
AUGMENTATION OF WASTEWATER**

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**ABSTRACT**

Water runoff from agricultural fields and landfills contribute to the ever-increasing problem of water pollution. Pollutants from runoff are not only fatal for the ecosystem but also cause significant harm to the human health. Runoff from urban areas contain high levels of heavy metals which istoxic for the human health. Further, pollutants such as polycyclic aromatic hydrocarbons, high level of nitrate in animal waste can lead to fatal conditions in humans such as the one in infants called infant methemoglobinemia or blue baby syndrome. Traditional treatments for these pollutants include excavation, transport to landfills, incineration, stabilization and vitrification. However, bioremediation particularly phytoremediation offers a comparatively sustainable and ecologically friendly remedial option. Phytoremediation to treat wastewater pollutants can be augmented using endophytes. The endophytes interact and exchange genes with the rhizospheric and phyllosperic bacterial communities, this gradually gives the overall microbial community degradation capabilities. It is also speculated that phyto remediating plants selectively recruit xenobiotic degrading endophytes from the surroundings. Advantage of using endophytes in phytoremediation lies in the fact that they can degrade the xenobiotic component in planta thus reducing the phytotoxic effects and toxic effects on the herbivore community. The three-wayinteraction among the endophytes, the plants and the pollutants set the foundation of phyto augmentation.

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**PP-17**

**ENDOPHYTES: A BIO-CONTROL AGENT**

**Sarthak Bansal<sup>1</sup>, Pooja Singh<sup>2</sup> and Shoma Paul Nandi<sup>3\*</sup>**

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**ABSTRACT**

Endophytes are an endosymbiotic group of microorganisms (bacteria or fungi) that colonize in robust plant tissue or other microbes without harming the plant. They have their life cycle completely or partially in plants. They protect the plant from many natural calamities like drought, water stress, salinity and also it protects the plant from harsh weather conditions and pathogenic attacks. In this study different mechanism of biocontrol caused by endophytes are being discussed, how endophytes protect the plant from pathogens. To protect the plant from pathogens biocontrol mechanisms are used. They are widely practiced in field of agriculture as there is a need of this on a large scale. To protect the crop from different pathogens different chemicals are used which also are economically expensive and ruin the soil and ground water quality by contamination. Endophytes fight against different pathogens and also do not harm the other natural elements. Thus, endophytes are a better option in various aspects (economically, chemically and physically). Potential endophytes are tested for antagonistic effects in vitro and in vivo using a variety of methods, including mycoparasitism, the synthesis of lytic enzymes and/or antibiotics, and the development of plant defenses. Efforts are currently underway to commercialize these biocontrol drugs. Endophytes as bio control agents may benefit from a sustained research pipeline that includes screening, in vitro and in vivo testing, biomass production, and commercialization that may contribute to a sustainable agriculture. The most common examples of some endophytes are Trichoderma (fungi) and pseudomonas, bacillus and rhizobium (bacteria).

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**VERMICOMPOSTING: AN ECOFRIENDLY  
WAY TO CONVERT FARM WASTE TO WEALTH**

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**ABSTRACT**

Injudicious application of chemical fertilizers after introduction of Green Revolution, results in continuous deterioration in soil fertility. Due to Deficiency and decrease of organic matter, macronutrient, micronutrient, and Trace element, result in earth worm population and beneficial microorganism declined in soil. Keeping in view to above and to enhance the profitability of farmers by recycling of farm waste, vermicomposting is an eco-friendly technology and based on sustainable agriculture. Livestock and crop production activities generate huge amount of biodegradable waste. Scientific approach to handle this waste by converting it into value-added organic product like vermicompost, vermiwash and high quality animal protein with the help of Earthworm generate profit and employment for rural youth, woman and farmers. These products improve soil health, maintain clean environment, conserves soil & enhance population of beneficial Microbes. There are several species of earthworm like *Eudriluseugeniae*, *Eisenia foetida*, *Perionyx excavates* and *Perionyx sansibaricus* have been identified as efficient Earthworm to Harbour on Farm waste and produce vermicompost. These worm grind big particles into small particles by gizzard & the gut of worm contain microorganisms and enzymes that help in processing of biodegradable wastes. Earthworm eats garbage more than their body weight in one day and excretes about 33% into Vermicast to consumed amount of feed and helpful in maintaining clean environment of village and Cities. Burning of farm waste raised concerned since last decades, vermicomposting help in reducing air pollution and decrease greenhouse gases emission produce by burning of crop residues. The multiplication of earthworm and favorable microorganism (using earthworm as a bioreactor) by utilizing organic waste add as additional source of income to Farmers. Liquid extracted from vermicompost and waste of earthworm is termed as vermiwash which contain certain Plant Growth Regulators that promote plant to fully exploit its genetic potential. On chemical analysis of vermicompost on several parameter it has been observed that its pH, organic carbon(%), N(%), P(%), K(%), Ca(%), Mg(%) are 6.7, 13.6, 2.6, 9, 2.95, 7.8 and 2.44 respectively. Micronutrient like Zn, Cu, Mn and B are 22, 5, 85 and 33 ppm respectively. In totality, vermicompost nutrient back to crops for increasing sustainable production in ecofriendly pollution free manner.

**Keywords:** Earthworm, vermicompost, vermiwash, ecofriendly, biodegradable, soil fertility.

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**PP-19**

**GREEN CHEMISTRY FOR DESIGNING  
A SUSTAINABLE FUTURE TUBER PROTEOME  
ANALYSIS OF DIOSCOREA ALATA REVEALS DIFFERENTIAL  
REGULATION OF GROWTH  
-ASSOCIATED PATHWAYS DURING TUBER  
DEVELOPMENT**

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**ABSTRACT**

Dioscorea tuber undergoes multiple morphological and biochemical changes during its life cycle. A stage-specific gel-free proteome analysis of four distinct morphological stages namely germinating tuber (S1), degrading tuber (S2), new tuber formation (S3) and tuber maturation (S4) was done and validated by principal component analysis. A comprehensive data set identifying 78.2% of the total 3,681 proteins was generated. PANTHER and KEGG MAPPER revealed both expected (carbohydrate metabolism and redox regulation) and novel biological processes (transcription factors and hormonal regulation) characteristic for each developmental stage.

Higher abundance of the enzymes of ascorbate–glutathione cycle and carbohydrate metabolism was detected during tuber germination (S1) and tuber formation stages (S3) in comparison with the mature tuber. The presence of ethylene biosynthesis components during tuber formation hints toward its probable role in postharvest shelf life. The data set comprehensively describes the proteome of Dioscorea tuber and provides growth-specific markers for tuber germination (ascorbate peroxidase, monodehydroascorbate reductase, invertase) and tuber formation (sucrose synthase), which were validated by enzyme activity assays and Western blotting. The study provides information that may influence the direction of research for improving the productivity of this under-utilized and largely neglected crop.

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**PP-20**

**ROLE OF ENDOPHYTES ON ABIOTIC  
STRESS MANAGEMENT OF PLANTS**

**Sini Kumari<sup>1</sup>, Pooja Singh<sup>2</sup> and Shoma Paul Nandi<sup>3\*</sup>**

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**ABSTRACT**

Endophytes are microorganisms maybe fungal or bacterial that live inside the plant's root or shoot in a symbiotic relationship. They cause no harm to the plants and are beneficial. One of the benefits that these endophytes provide is they manage growth of plant under stress conditions like drought and salinity, temperature and heavy metal stress. This study focuses on the fact that how these microbes through various mechanism and approach provide tolerance against abiotic stress. Endophytes have the ability to act as plant growth promoters through the production of plant hormones like indoleacetic acid produced by plant growth promoting rhizobacteria, gibberellic acid, cytokinin, Salicylic acid and Abscisic acid, osmolytes like proline, glycine and betaine, and induced expression of defective genes. Endophyte's colonization can also grow plants in contaminated soil through the decomposition of dangerous compounds. A good strategy for reducing stress in plants without cooperation of plant growth is to use plant growth promoting factors. To improve plant growth, metabolites produced by endophytes are used in a wide range of mutants. Comparison was done on plant with endophyte colonization and without endophyte colonization and it was seen that with endophytes there is higher crop yield as compared to plant without endophyte. Exploiting valuable endophytes is critical in light of rising interest in environment protection, food security, and sustainable agriculture. Plants that have adapted to a variety of stresses, such as drought, salt, temperature, and heavy metals, can employ them as an alternate strategy.

**Keywords:** Endophytes, Plant Growth promoting factors, abiotic stress, environment protection, plant hormones.

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PP-21

**EVALUATING THE WATER STABILITY  
INDICES FOR DRINKING-MINING-METALLURGICAL  
USE : ISOTOPIC FOOTPRINTS AS CORROSION TRACERS IN  
SUBARNAREKHA WATERSHED, GHATSHILA, INDIA**

**Susnata Ray<sup>1</sup>, Swagupta Biswas<sup>1</sup>, Archana Deodhar<sup>2</sup>  
Md. Arzoo Ansari<sup>2</sup> and Sharadindra Chakrabarti<sup>1\*</sup>**

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**ABSTRACT**

The water indices that entail corrosion and scaling potential are major qualifiers for the safety and security of public water supply system, and health of end users thereof. There are rising public health concerns for delineating the corrosion properties that are deterrent to water utilities. Corrosion favours heavy metal leaching into water, and shield microorganisms from disinfectants. Rapid economic development, population growth and urbanization have kindled the need of advanced water treatment and supply network for potable, irrigation and industrial use. The presence and release of corrosion activators from heavy metal-mining complexes, and their associated processing plants (active/abandoned), through discharge of acid/alkaline/metal effluents has important implications for environment. Mining operations involving sulphide minerals generally result in excavation of rocks and minerals from subsurface anoxic onto surface oxic environment. This transformation triggers leaching of strong acids and metals that find way into neighbouring soil, surface- and ground- water regimes. In the process, corrosion aggravators get access to streams and rivers, with latent deleterious reactions occurring even decades to centuries later. The present study highlights the characterization of water corrosion potential in mining impacted water milieus of Subarnarekha river basin, East Jharkhand, and find out their geo-spatial imprints on hydrogeochemical systems. The research is carried out in Singhbhum mineral belt around the Mosabani/Rakha/Surda copper mine-smelter units and Jaduguda Uranium mine. So far, there has been no concerted effort to find out the corrosion and scaling potential of Subarnarekha with multi-isotopic ( $\delta^{18}O$  and  $\delta^2H$ ) and geochemical approaches. Analyses reveal that Subarnarekha water is dominantly under-starved in terms of water scaling potential index. The river water has moderate irrigation potential, and stand unfit for domestic use in many stretches. The findings enunciate framing of a conjunctive master plan to rejuvenate the Subarnarekha basin from the provenance and precursors of pollution.

**Keywords:** Corrosion potential, Isotope, Metal-mining, Pollution, Subarnarekha .

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PP-22

**FLUORIDE IN GROUNDWATER OF  
BARINDALLUVIAL TERRACE OF SOUTH  
DINAJPUR, WEST BENGAL: MEDICO-GEOLOGICAL  
PROBLEMS AND SCOPE FOR ENVIRONMENTAL  
REMEDICATION**

**Susnata Ray<sup>1,2</sup>, Goutam Paul<sup>1</sup> and Sharadindra Chakrabarti<sup>2\*</sup>**

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**ABSTRACT**

Fluoride is an essential trace element of drinking water that acts beneficial for human health within optimum limits (0.6 to 1.2 mg/L). Chronic ingestion of excess fluoride leads to severe fluorosis, while deficiency causes dental retardations. A total of 61 blocks spread over 6 districts are currently reeling under fluoride pollution in West Bengal. The South Dinajpur district that lies on Barind Alluvial terrace skirting the sub-Himalayan Terai formation of West Bengal has reported geogenic fluoride as high as 7.49 mg/L from Gangarampur block. A wide interplay of statistically-significant and well-correlated hydrochemical factors operating under diverse hydro-geological and physico-chemical conditions have gradually triggered geochemical leaching of fluoride from the host country rock. Medico-geological surveys carried out in the captive reaches of affected tube wells have revealed strong symptoms of dental fluorosis in infants, while adults are victims of skeletal fluorosis. The total district population at risk due to high fluoride (1.0mg/L and more) is around 462071 (2018-19 PHED data). Treatments envisaged so far by government/non-governmental initiatives proved expensive, and failed to produce the optimum results. De-fluoridation through adsorption by nano-crystalline aggregates of Mixed Metal Oxides (MMOs) developed in the laboratory has showed superior scavenging of fluoride as part of environmental nano-remediation. The study entails design and field validation of novel, low-cost, eco-friendly, nano-treatment filters, based on the newly developed filter pack, as attachment to public water stand posts. The research is an innovative holistic endeavour to conjunctive water management enunciating the fate, transport and attenuation of fluoride in sub-surface hydrological domains.

**Keywords:** Adsorption, Barind, Correlation, Fluoride, Groundwater, Nano-remediation.

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PP-23

**CORROSION AND SCALING POTENTIAL  
OF KUMARI RIVER OF PURULIA DISTRICT  
WEST BENGAL, INDIA: CONJUNCTIVE MANAGEMENT  
OF BASE FLOWS (CHUA) AND HYPORHEIC ZONE FOR  
RURAL PUBLIC WATER SUPPLY SYSTEM**

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**ABSTRACT**

Corrosion has emerged as a key decisive parameter in ensuring water quality for industrial and potable use. Corrosion indices are quantitatively derived from specific water quality parameters that cast strong influence on human health, as well as safety and sustainability of the civil (public health)/structural design of water intake works and conveyance system. In view of prevalent extreme arid conditions in Purulia district of West Bengal, there is perennial shortage of potable water in this drought-prone Chotanagpur Gneissic province. The lean surface and sub-surface base (Chua) flows available in Kumari river, the major lifeline of human existence of this region, are directly abstracted from the river front by captive habitations residing on river banks. There are a series of miniature intake wells and feeder systems installed by local bodies that principally extract the channel flow from the domains of surface flow, subterranean (chua/base) flow and hyporheic storage zone. Kumari is a gaining (effluent) stream that shares connectivity and recharge from adjacent bank aquifers. The environmental sustenance of improvised water supply systems depends upon the state of stabilization and equilibrium of the water potential zones in terms of various corrosion indices namely, (i) Ryznar Stability Index (RSI), (ii) Puckorius Scaling Index (PSI), (iii) Langlier Saturation Index (LSI), (iv) Aggressive Index (AI), (v) Larson-Skold Index (LS) and (vi) Corrosivity Ratio (CR). Each of these parameters has been evaluated in context of Kumari water at different study stretches and geospatially demarcated into contour maps. The results reveal that Kumari is dominantly under-starved in terms of water scaling potential index. The riverine stretch may thus be considered for direct river-lift potable schemes across favourable longitudinal and transverse profiles through creation of infiltration galleries/sanitary wells/river bed tube wells with horizontal strainers/slotted (porous) pipes, and conveyed into distribution mains after suitable treatment in bank locales.

**Keywords:** Bank Storage, Corrosion, Hyporheic Zone, Kumari River, Scaling Potential.

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PP-24

**IDENTIFICATION AND CONSERVATION  
STRATEGY FOR THE ECOLOGICALLY  
IMPORTANT FODDER SPECIES IN KULLU  
BLOCK, NORTH WESTERN HIMALAYA**

**Twinkle Thakur, Sarla Shashni, Anjali Mehta and Vinod Kumar**

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**ABSTRACT**

In Indian Himalayan Region, livestock is one of the most important sources of livelihood for the rural people. For their day-to-day food and nutritional needs, livestock are mostly dependent on various fodder plant species available in nearby forests, grasslands, agriculture fields, etc. These fodder resources are also very important for the management of natural resources. The present study is focused on identification and its conservation strategy of ecologically important fodder species in the Kullu Block, Himachal Pradesh. A total of 60 species of wild and cultivated fodder plants, which represent trees (17), herbs (22), shrubs (8) and grasses (12) belonging to 20 families, have been identified in the region. Different parts of these species, such as leaves, stems, roots, fruits, grains, whole plants, etc. are used as fodder by the local inhabitants. These recorded species have been used as green fodder, dry fodder and alternate fodder throughout the year. The study also revealed that due to overharvesting, habitat destruction, change in environmental conditions, these resources are slowly depleting. Therefore, appropriate strategies and actions should be taken for the conservation and sustainable management of these fodder species in the region to ensure their future use.

**Keywords:** Fodder Species, Diversity, Kullu Block, Sustainable, Conservation.

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PP-25

**INFLUENCE OF HYDROLOGICAL FACTORS AND DIFFERENT  
FOREST TYPES ON OCCURRENCE  
OF ANTHRAX OUTBREAKS IN KARNATAKA, INDIA**

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**ABSTRACT**

Anthrax is a zoonotic disease caused by *Bacillus anthracis*, a gram-positive, spore-forming, rod-shaped bacteria that primarily affects herbivore animals. Humans become infected by coming into contact with infected animals. Animal carcasses are either disposed in agriculture fields or in rivers/river streams. The anthrax spores can survive in soil for many years leading to anthrax cycle of infection to be maintained in endemic regions. Identification of the hydrological factors such as presence of water bodies or rivers or streams is important to advice livestock farmers on preventive measures such as carcass disposal and effective vaccination. Presence of forest near endemic regions will also play an important role considering the role of wild ruminants, especially elephants in transmission of the disease to domestic ruminants. Hence, in this study it was aimed to identify the hydrological factors and presence of forest in determining the occurrence of anthrax outbreaks in Karnataka state of India. The selected main predictor variables were used to fit the binary logistic regression model. It was found that the distance to river-line ( $p=0.05$ ), distance to Wet evergreen forest ( $p=0.00$ ), distance to Semi Evergreen forest ( $p=0.00$ ), and distance to Thorn forest ( $p=0.001$ ) were positively associated and Sub tropical broad leaved forest ( $p=0.00$ ) was negatively associated with the occurrence of village level occurrence of anthrax in Karnataka. Hence, effective vaccination and proper disposal of carcass can prevent the occurrence of anthrax in animals and subsequent transmission to humans.

**Keywords:** *Bacillus anthracis*, hydrology, forest, stepwise regression analysis, Binary logistic regression model.

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**PP-26**

**CONSERVATION AND MANAGEMENT  
OF INDEGENOUS BEE SPECIES (APIS CERANA)  
IN TIRTHAN VALLEY, HIMACHAL PRADESH**

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Himachal Regional Centre, Mohal-Kullu, 175126, Himachal Pradesh

**ABSTRACT**

Beekeeping with indigenous bee species *Apis cerana* is a century old practice in the rural areas of Himachal Pradesh. It has a great commercial value linked with various horticultural and agricultural crops production in the region. In the time of modernisation this century old practices are getting vanished from the rural areas very fast. Current study is an attempt to revive this indigenous technique of beekeeping by managing the colony in modern hives. Study is being carried out with the group of 100 beekeepers in Tirthan Valley for the conservation and management of the bee species. For successful implementation of the activity, beekeeping aspect is also linked with entrepreneurship through value addition of hive products such as honey, wax, etc. and its marketing. Other environmental aspects such as pollination, bee flora, bee colony management etc were also popularised among the beekeepers group. The activity is contributing towards the conservation of local bee species, environment and rural livelihood for its overall sustainability in future.

**Keywords:** Beekeeping, Conservation, *Apis cerana*, Pollination, Sustainable.

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PP-27

**SOME ECOLOGICAL ASPECTS OF A LENTIC  
WATER BODY WITH EMPHASIS ON ITS  
RESTORATION AND MANAGEMENT**

**Vikas Kumar<sup>1</sup>, Wahab Alam<sup>1</sup>, Navin Kumar Ojha<sup>2</sup> and Manoj Kumar Pandey<sup>3</sup>**

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<sup>3</sup> Dept. of Zoology, Ganga Singh College Chapra-841301

**ABSTRACT**

This paper dealt with an application of ecotechnology to monitor and restoration of an aquatic body which had already infested and recognised as an eutrophic stage. Hence, keeping this view in mind the current research work analyses the causes and concerns of the characteristic features that have been altered by the abnormal changes in the physico-chemical and biological parameters of the water body. To know the real driving force of the problems following parameters have been analysed carefully i.e TDS.Temp. EC. PH. DO. and BOD on regular basis. Biological parameters have also taken into consideration and the biotic indicators analysed to check the biological community variety and variability in particular phase.

**Keywords:** PH, TDS, DO, light intensity, temperature production, etc.

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**PP-28**

**STUDY ON THE GROSS PRIMARY PRODUCTIVITY  
OF A TROPICAL LENTIC WATER BIOTOPE**

**Wahab Alam<sup>1</sup>, Vikash Kumar,<sup>1</sup> Navin Kumar Ojha<sup>2</sup> and Manoj Kumar Pandey<sup>3</sup>**

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**ABSTRACT**

In order to formulate techniques for maximal utilization of resources of lentic bodies a comprehensive study of primary production is an indispensable prerequisite. Various explanation has been offered to account for usually high productivity in certain water bodies including variation in nutrients concentration, current velocity, light intensity and temperature production rate in all aquatic system reaches are closely dependent on the nature of substrate because bottom materials provided different opportunities for attachment of benthic producer organisms and thus are influenced by primary production rates. The production by autotrophs can be expressed as the gross or net primary production. The gross primary production is difficult to determine directly but can be computed by adding the metabolic activities of the plant to quality lost in respiration to net production. The total energy assimilated by the organism in a given time is gross production in plants. At site 1, the GPP depicted a definite seasonality; the lowest value was recorded in December, 2018 (2.914 g/m<sup>2</sup>/y) and the highest in May, 2019 (9.742 g/m<sup>2</sup>/y) during the first year of observation. In the second year, there was slightly different trends, the minimum (2.197 g/m<sup>2</sup>/y) was recorded in September, 2020 and the maximum (8.473 g/m<sup>2</sup>/y) in April, 2020. At site 2, the minimum (1.693 g/m<sup>2</sup>/y) GPP was observed in November 2018 and maximum (6.941 g/m<sup>2</sup>/y) in May, 2019 in the first year of study. During the second year, the lowest was in December, 2019 (1.313 g/m<sup>2</sup>/y) whereas the highest (7.472 g/m<sup>2</sup>/y) in April 2020. The GPP of lentic habitats showed similar seasonality. The higher values were observed in summer while it was lower at all sites.

**Keywords:** Gross Primary Productivity, light intensity, temperature production, etc.

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PP-29

**RENEWABLE BIO ENERGY  
FOR SUSTAINABLE ENVIRONMENT**

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**ABSTRACT**

Bio energy is already making a substantial contribution to meeting global energy demand providing environmental benefits, contributing to energy security, improving trade balances, providing opportunities for social and economic development in rural communities and improving the management of resources and wastes. Bio energy is the only renewable source that can replace fossil fuels by 2050. Production of bio energy from plant sources has long been researched, but with the rising population there is an added issue of the food vs. fuel controversy, Considering this microbial sources for bio energy production can serve the fulfilling the energy demand. In this paper lipid production from various microbial sources is studied, with biochemistry of lipid accumulation, biosynthesis of fatty acids and triacylglycerides which comprise the majority of the lipids. Emphasis is placed on different biochemical and metabolic strategies adopted to improve lipid yields for biofuel production.

Regard to this screening of bacterial isolates for lipid production was carried out and found that in *Rhodotorula glutinis* 72(%), *Schizochytrium linacinum* 64(%), *Lipomyces starkeyi* 63(%), *Cryptococcus albidus* 60(%), *Rhizopus arrhizus* 57(%), *Mortierella isabellina* 50(%), *Chatoceros muelleri* 50(%), *Pythium ultimum* 48(%), *Yarrowialipolytica* 36(%), *Chlorella* sp. 30(%), *Mucor circinelloides* 25(%), *Rhodococcus opacus* 23(%) later molecular characterization was done and lipid inclusions were visualized in the screened isolates by fluorescence microscopy. Then analysis of fatty acid methyl esters was done by Gas chromatography-mass spectrometry and analysis of triacylglycerol by MALDI-TOF.

The strain improvement was done by protoplast fusion GC and FTIR were used for analysis of FAMES. Investigate the diacylglycerol acyl transferase (DGAT) gene expression in the oleaginous isolate for relative expression of Tuf and DGAT genes.

**Keywords:** Bio energy, lipid bacteria, triacylglycerol, diacyl glycerol acyl transferase, Tuf

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**PP-30**

**NUTRIENT ANALYSIS OF CERTAINED EDIBLE  
MICROGREENS AND SOLDIER'S ACCEPTABILITY  
AS FRESH FOOD SUPPLEMENT AT HIGH ALTITUDE**

**Seema Rani and Narendra Singh**

Defense Institute of High Attitude Research-Defense  
Research & development Organization Leh-Ladakh

**ABSTRACT**

Cold arid region like Ladakh is one of the most difficult terrains in the world. The populations at high altitudes including soldiers deployed at borders region are heavily dependent on imported food from other regions of India for their food and nutrition security. Adequate nutrition is essential requirement to maintain the physical and mental efficacy of soldiers for performances in operational situations. A very short growing season makes the fresh food scarceness in region thus fresh food (vegetables and fruits) is transported by air route from other places to Ladakh. It increases the transportation cost, engagement of technical manpower and losses in quality and quantity of produce. At the time of non availability of fresh; troops are mainly dependant on tinned/packaged food at such remote locations. The regular use of processed foods can lead to excess intake of sugar, salt, fat and other preservatives and can be deficient in required phyto-nutrients which may cause various health issues. There fore need of the self reliant, short duration and easy growing approach of obtaining fresh food was realized. Microgreens farming has been evolved to enhance the availability of fresh food and nutrient diversity in daily diet of soldiers. These microgreens are tiny (8 to 10 cm height) young edible greens plantlets, harvested within 10 -12 days. They are very rich in nutrients like vitamins, minerals & other beneficial bio-active compounds. In context of the need, six crops i.e. radish sunflower, moong bean, cabbage, peas, and broccoli as microgreens have been selected for preparing the 100 g dose for daily intake by soldiers. The nutrition analysis of these six microgreens illustrated that moong bean are richer among the six in energy (63.08 Kcal/100 g), dietary fibre (4.89 %) magnesium (600 mg/kg), manganese (7.8 mg/kg), potassium (7700 mg/kg), vitamin B2 (1.42 mg/kg), vitamin B3 (180.2 mg/kg) and beta carotene (10590 mg/kg). Pea microgreen is qualitatively rich in protein (7.87%) and total nitrogen (12600 mg/kg). Sunflower is comparatively loaded higher with iron (203 mg/kg), zinc (9.6 mg/kg) and vitamin A (50.13 mg/kg). Radish microgreens have additional amount of fatty acid (1.79%), sodium (580 mg/kg) calcium (587 mg/kg), phosphorous (1600 mg/kg), vitamin E (22.4 mg/kg), vitamin C (149 mg/kg) and vitamin B1 (3.46 mg/kg) as compared to other five microgreens. As a result, it can be stated that soldiers may get diverse amount of minerals vitamins and other beneficial compound through this novel approach of growing and consuming fresh food at their own locations. The soldiers' acceptability to consume microgreens as fresh food supplement in their daily diet at high altitude is higher without any side effect on health.

**Keywords:** Ladakh, high altitude, microgreens, food security, fresh food, nutrient assessment

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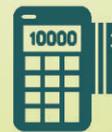
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