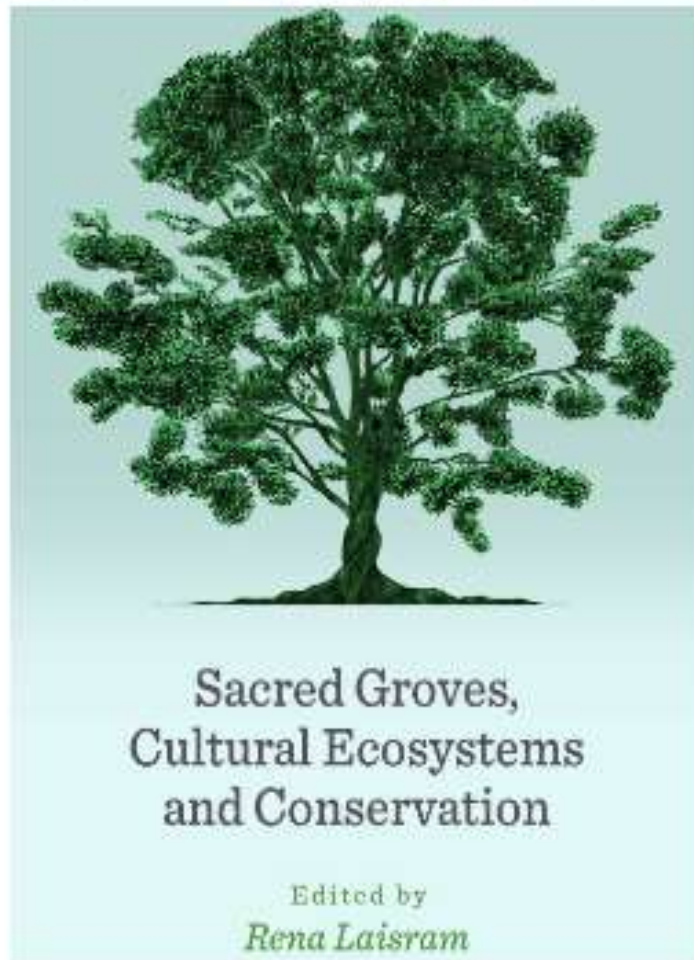


# Vanishing Sacred Groves

Published on 23 May 2023

*Rena Laisram tries to bring together a collection of essays in this edited volume, which looks into these important cultural & religious sites, which are vanishing day by day, especially in Asia and Africa.*



Cover Page

## Editor

[Rena Laisram](#)

[Department of History, GU](#)

## Abstract

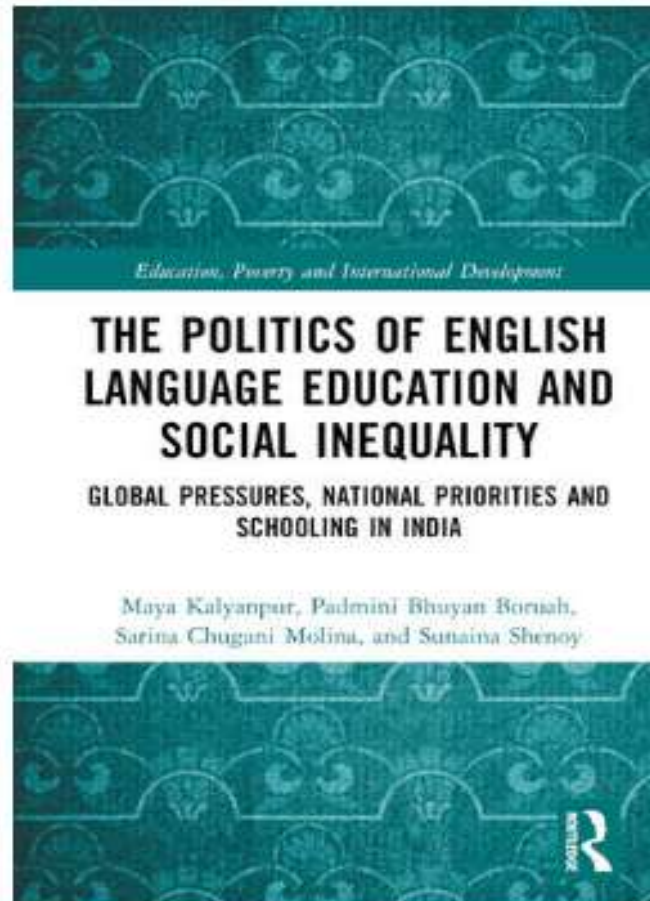
Sacred Groves, Cultural Ecosystems and Conservation addresses the increasing contemporary relevance of ecosystems being depleted at an alarming rate worldwide. The purpose of this collection of essays is to bring together different perspectives on sacred groves in the context of the cultural and spiritual dimensions of biodiversity conservation. In offering an experience of sacred natural sites in varied cultural contexts of Africa and Asia, it raises a common concern for natural resource management. Based on the long-term research of the contributing authors, the nine chapters reflect a continuous process of redefining sacred spaces within an interdisciplinary framework grounded on existing literature and ethnographic field research. The highlight of the discourse is the complex interactions and negotiations between the 'sacred' and the 'secular'; which brings center-stage the subject of sacred status that communities have given to nature. This book will be of interest to researchers and general audience alike interested and concerned with earth ecosystems and the spiritual world, creating a space for critical enquiry and future hopes in the face of threatening habitat loss.

## References

[Sacred Groves, Cultural Ecosystems and Conservation \(Ed Rena Laisram, Cambridge Scholars Publishing 2023\)](#)

## The politics of language education

Padmini Bhuyan Baruah and coauthors explain the politics of English language education and social inequality in the context of India, in the book [\*The Politics of English Language Education and Social Inequality: Global Pressures, National Priorities, and Schooling in India\*](#).



### Authors

Maya Kalyanpur<sup>1</sup>, [Padmini Bhuyan Baruah](#), Sarina Chugani Molina<sup>1</sup>, and Sunaina Shenoy<sup>1</sup>  
[Department of English Language Teaching, Gauhati University](#)

<sup>1</sup> from other institutions

### Description

Based on policy analysis and empirical data, this book examines the problematic consequences of colonial legacies of language policies and English language education in the multilingual contexts of the Global South. Using a postcolonial lens, the volume explores the raciolinguistics of language hierarchies that results in students from low-income backgrounds losing their mother tongues without acquiring academic fluency in English.

Using findings from five major research projects, the book analyzes the specific context of India, where ambiguous language policies have led to uneasy tensions between the colonial language of English, national and state languages, and students' linguistic diversity is mistaken for cognitive deficits when English is the medium of instruction in schools. The authors situate their own professional and personal experiences in their efforts at dismantling postcolonial structures through reflective practice as teacher educators, and present solutions of decolonial resistance to linguistic hierarchies that include critical pedagogical alternatives to bilingual education and opportunities for increased teacher agency.

This timely volume should appeal to researchers, scholars, academics, and students in the fields of international and comparative education, English and literacy studies, and language arts more broadly. Those interested in English language learning in low-income countries specifically will also find this book to be of benefit to their research.

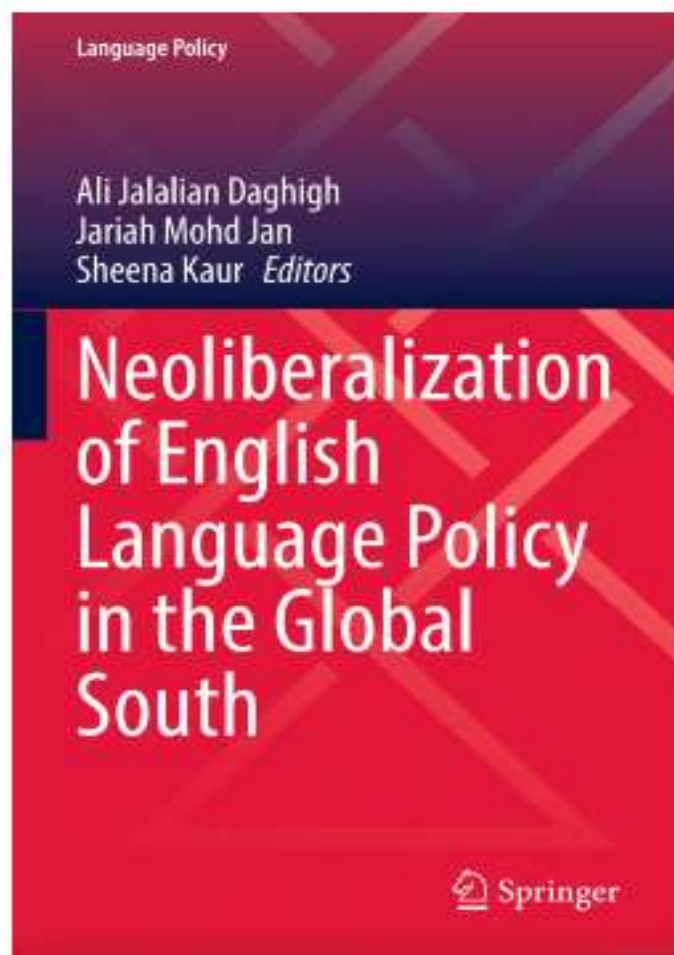
### Reference

[\*The Politics of English Language Education and Social Inequality\* \(Routledge 2023\)](#)



## Challenges to multilingual language policy

*Padmini Baruah looks into the challenges in implementation of multilingual language policy in India with reference to English medium education in this book chapter.*



### Authors

[Padmini Baruah](#) and [Ajit Mohanty](#)<sup>1</sup>

[Department of English Language Teaching, Gauhati University](#)

<sup>1</sup> *from another institution*

### Abstract

A parallel education industry largely unaddressed in national language education policy framings, English medium education (EME) in India thrives and is buoyed by the neoliberal constructs of the individual/institutional agency and responsibility for economic success. Most studies on Indian English language education place the inequities perpetuated by neoliberalism as a construction of the elite classes who act as gatekeepers for English, but the issue is far more complex. The chapter argues that the economically stable middle class babysits English and keeps the neoliberal rhetoric alive through investment in EME. It discusses other factors that allow a neoliberal construction of English, such as the absence of national consensus on an 'official' language or on diversity of *lingua franca(s)* to negotiate life beyond community and state, the role of teachers and the nature of ELT pedagogical practices prescribed by national curricular frameworks. In short, the chapter critiques the overt and implicit ways by which English medium education (EME) in India promotes and sustains the neoliberal regime and provides continual resistance to the implementation of a healthy multilingual education policy.

### Reference

[in \*Neoliberalization of English Language Policy in the Global South\* \(Eds Ali Jalalian Daghigh, Jariah Mohd Jan, and Sheena Kaur, Springer 2022\)](#)

## Plant stress in a changing climate

*Nabanita Bhattacharyya analyses the management strategies for native plants of wastelands in a changing climate scenario in this book chapter.*



Image : Plants under stress (photo by [Gerald Hinzen](#))

### Author

[Nabanita Bhattacharyya](#)

[Department of Botany, Gauhati University](#)

### Abstract

Industrial and mining waste dumping is among the most concerning anthropogenic causes of the formation of stress-laden wastelands, which are characterized by loss of plant cover and subsequent land degradation. Under the pressure of changing climate, the revival of the degraded wastelands into productive lands becomes a sustainable option to meet the basic survival demands of the increasing human population. Restoration of vegetation cover is a widely accepted eco-friendly approach for remediation of degraded wastelands over physical or chemical strategies. However, the successful establishment of plants in wastelands is a difficult process due to the phytotoxic nature of the wasteland soils. Therefore, the use of naturally growing native plants, which thrive well in the adverse soil properties of degraded lands with little or no agronomical effort, is an effective option. Some of these plants might have phytoremediation potential, which is a sustainable technology for the remediation of contaminants including heavy metals from soil and water by using plants. Documentation of such stress-tolerant naturally growing plants of various wastelands and studying their mechanism of tolerance are among the major emerging areas of research in recent times. Such efforts may help in finding novel plant species that are more stress-tolerant with greater potential of creating vegetation cover on degraded wastelands. Therefore, for the benefit of interested researchers and policymakers, an attempt has been made to review and comprehensively document the discrete information, from available sources, on naturally growing native plants of various industrial and mining wastelands, their stress management strategies and phytoremediation prospects in changing climate.

### Reference

[in \*Plant Stress: Challenges and Management in the New Decade\* \(Eds. S Roy, P Mathur, AP Chakraborty, and SP Saha, Springer, 2022\)](#)



# Neutrino physics and dark matter

*Kalpna Bora and graduate students investigate the ever puzzling properties of the subatomic particle called neutrino and dark matter in these three book chapters.*

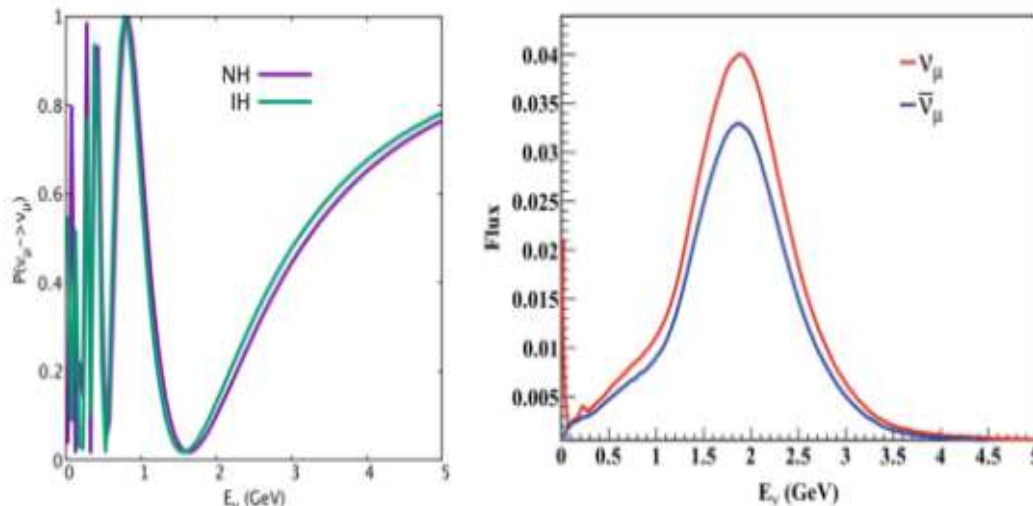


Figure : Survival probability of  $\nu_\mu \rightarrow \nu_\mu$

## Authors

Nilavjyoti Hazarika and [Kalpna Bora](#)  
 Paramita Deka and [Kalpna Bora](#)  
 Maibam Ricky Devi and [Kalpna Bora](#)  
[Department of Physics, Gauhati University](#)

## Abstract #1

The presence of dark matter is an exciting and puzzling feature of our Universe. Although the presence of dark matter is strongly supported by many astro-physical and cosmological observations, there is no candidate of dark matter in the standard model (SM) of particle physics. Different extensions of the SM provide candidates of dark matter. In this work, we consider scalar extensions of SM—a singlet scalar (SSM), an inert scalar doublet (IDM) and a mixed scalar model (MSM) to explain the existence of dark matter. The SSM faces a large number of experimental and theoretical constraints, most notably from the results of direct detection experiments like XENON1T. The IDM on the other hand can be valid up to the Planck scale ( $M_{PL}$ ). The MSM DM model is an admixture of SSM and IDM. In MSM, we consider mixing between the singlet and the CP-even component of inert doublet dark matter particles. The lightest neutral Higgs that comprises the CP-even component of inert doublet and the singlet scalar is considered to be the DM candidate. We find the parameter space, which is consistent with the constraints of relic density. The current limits from the XENON1T experiment are used to study the constraints on the parameter space of the models and match our theoretical results with the same.

## Abstract #2

Nuclear effects in neutrino interactions are one of the major sources of systematic uncertainties in the neutrino beam oscillation experiments. Our present understanding of these effects is still insufficient. Another source of uncertainty is the energy dependence of neutrino oscillation probability which is a nontrivial function of the true incoming neutrino energy. The NUMI Off-Axis  $\nu_e$  Appearance (NOvA), a long-baseline neutrino oscillation experiment, is designed to measure  $\nu_e(\bar{\nu}_e)$  appearance probability and  $\nu_\mu(\bar{\nu}_\mu)$  disappearance probability at Fermilab's NUMI (Neutrinos at the Main Injector) beam. In this work, we use the kinematic method of reconstruction of the incoming neutrino energy, both at the ND and FD, and investigate the role of Multi-Nucleon (MN) effects on neutrino nucleus scattering cross section and event distribution at ND and FD of NOvA.

## Abstract #3

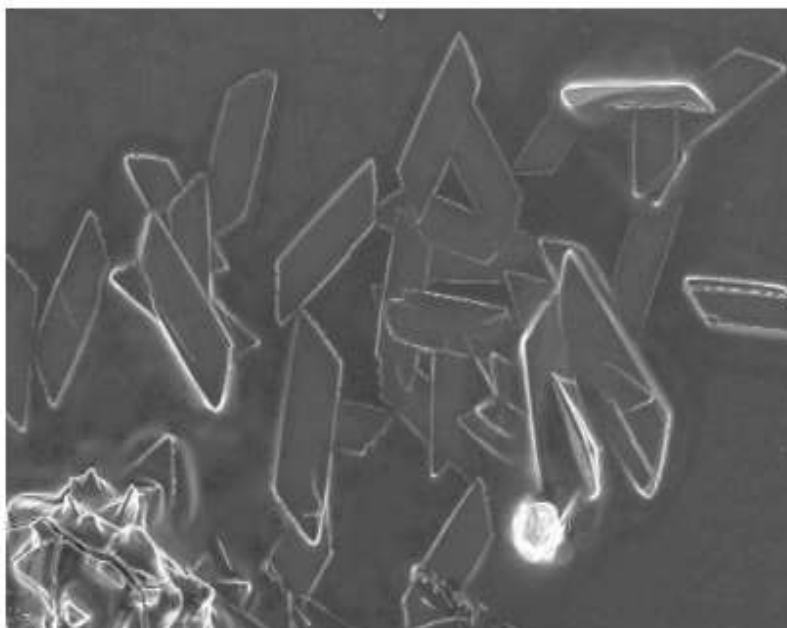
Sesaw mechanisms are used to generate the ultra-small mass of three active, observable neutrinos, in which three heavy right-handed Majorana neutrinos are needed. These three heavy Majorana neutrinos have so far remained undetected in the present-day collider experiments. The limits on this heavy neutrino mass spectrum can provide us interesting information on some other phenomenological aspects, such as the absolute mass scale of neutrinos and Leptogenesis, which remain unknown. In this work, we shall present a detailed analysis to measure the limits on the heavy Majorana masses for different textures of Dirac, Majorana and light neutrino mass matrices. We consider three zeroes texture of light neutrino mass matrix and a particular texture of Dirac mass matrix from which we can obtain heavy Majorana masses as well as the unknown neutrino oscillation parameters, viz., the lightest neutrino mass and the Dirac and Majorana CPV phases.

## Reference

[in Selected Progresses in Modern Physics \(Eds. S Sengupta, S Dey, S Das, DJ Saikia, S Panda, and R Podila, Springer, 2021\)](#)

# Synthesis of molybdenum disulphide nanosheet

*Sulochana Deb and her collaborator describe the process of synthesis of MoS<sub>2</sub> nanosheet in this book chapter.*



*Image : Scanning Electron Micrograph of the sheet.*

## Authors

[Sulochana Deb](#) and Jaysri Sarkar  
[Department of Physics, Gauhati University.](#)

## Abstract

In the field of nanotechnology, MoS<sub>2</sub> nanosheets have a wide range of applications because of their unique properties. Here, we report hydrothermal method of synthesis of MoS<sub>2</sub> nanosheet. The as-synthesized MoS<sub>2</sub> nanosheets are characterized by the Scanning electron spectroscopy (SEM), X ray diffraction (XRD) studies, UV visible spectroscopy, Photoluminescence (PL) spectroscopy and I-V characteristics to determine their morphological, structural, optical and electrical properties. The SEM image confirms the synthesis of well-shaped nanosheet like structure with length 9.6  $\mu\text{m}$  and breadth 3.2  $\mu\text{m}$  but the thickness is in the nanorange. The UV-Vis spectra show the absorption peak of MoS<sub>2</sub> at 313.13 nm and a band gap calculated is found to be 2.68 eV. The XRD peaks are observed at 14°, 25.46° and 33.79° corresponding to (002), (111) and (100) plane. XRD also gives the crystalline size of nanoparticles about 112.8 nm. Photoluminescence spectra shows that the maximum emission peak is at 465.79 nm for excitation wavelength at 350 nm. The I-V characteristic gives the information that the curve is nonlinear, asymmetric and the p-n junction are formed with the high reverse break-down voltage of MoS<sub>2</sub>.

## Reference

[in Proceedings of 28th National Conference on Condensed Matter Physics \(Eds. RG Nair, L Seban, and P Ningthoukhongjam, Springer, 2021\)](#)



## The new-found xenophobia

*Farddina Hussain analyses the idea of new-found xenophobia in two novels - [Night of Happiness](#) and [Jihadi Jane](#) by Tabish Khair in this book chapter. Tabish Khair is an Indian English author who is with the University of Aarhus, Denmark.*



Covers : Cover pages of the two books.

### Authors

[Farddina Hussain](#)

[Department of English, Gauhati University](#)

### Abstract

By following Khair's notion of new xenophobia, the chapter analyses two novels by Tabish Khair as Khair addresses the politics of viewing and representing the stranger, an "other" based on religion and culture. With the use of a narrator, Khair focuses on the dynamics of power, prejudices, and xenophobia in society. In his recent novel, *Night of Happiness* (2018), and his earlier novel, *Just Another Jihadi Jane* (2016), the ironical framework of the narratives exposes the problems of the individual against the collective in terms of identity formations and beliefs.

### Reference

[in \*Religion in South Asian Anglophone Literature\*, Chapter 1 \(Eds. Sk Sagir Ali, Goutam Karmakar, and Nasima Islam, Taylor & Francis, 2021\)](#)

## The summoning of Everyman

Bibhash Choudhury critically looks into the role of "Evil" in the 15th-century morality play -The Summoning of Everyman (The Summoning of Everyman), popularly known as "Everyman", in this book chapter.

Here begynneth a treatyse how þe  
fader of heuen sendeth dethe to so-  
mon euery creature to come and  
gyue a counte of theyr lyues in  
this worlde/and is in maner  
of a moꝛall playe.



Cover: Frontispiece from edition of *Everyman* published by John Skelton c.1526.

### Authors

[Bibhash Choudhury](#)

[Department of English, Gauhati University](#)

### Abstract

The moral question in the medieval morality play *Everyman* considerably bears the weight of the underpinnings of 'evil', which require addressing not just in terms of the situation of choice, but also as an exercise in human agency directed towards a movement out of the trappings in which *Everyman* finds himself. This paper seeks to examine the contours of the markings of evil, processing thereby the engagement of this motif that undercuts the standard articulation of the morality structure where its embedding is so closely subsumed. The dynamics of a socially induced ethos that is made to play its part in the summoning of *Everyman* is also looked into through a modern re-working of the same subject in the hands of a contemporary playwright as well, facilitating thus a reading that examines the possibility of tracing the unstated paradigms of evil in this play.

### Reference

[in \*Performativity of Villainy and Evil in Anglophone Literature and Media\*, pp 3 \(Ed Nizar Zouidi, Palgrave Macmillan, Springer Nature, 2021\)](#)



## Mechanochemistry of molecular crystals

*Ranjit Thakuria and collaborators discuss recent advances in the subject of mechanochemistry of molecular crystals, in this book chapter.*

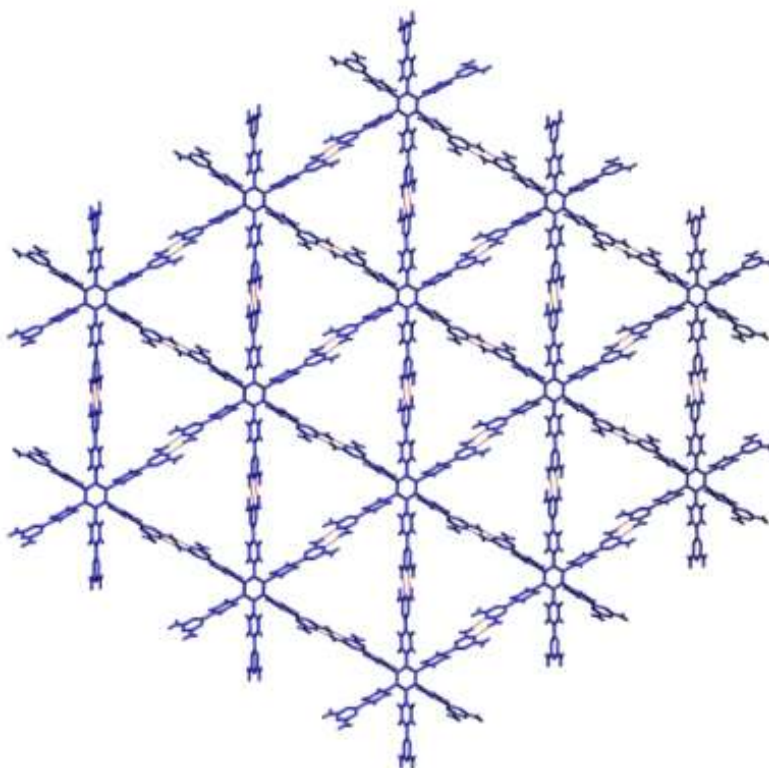


Figure : An example of crystal engineering using hydrogen bonding (from [Wikipedia](#) under CC License)

### Authors

Kashyap Kumar Sarmah, [Ranjit Thakuria](#), and Malla Reddy<sup>1</sup>

[Department of Chemistry, Gauhati University](#)

<sup>1</sup> from another institution

### Abstract

This book chapter covers the recent literature on structure–mechanical property correlation in mechanically soft molecular crystals and the role of nanoindentation and atomic force microscopy indentation techniques in understanding the intermolecular interactions and various other properties in the context of crystal engineering. The authors finally conclude with a proposal that the mechanical effects such as plastic, superplastic, superelastic, ferroelastic, elastic, and brittle deformation processes be considered as part of the mechanochemistry, as these processes also involve the reorganization of supramolecular interactions (often, phase transformations) in response to mechanical stimuli.

### Reference

[in Hot Topics in Crystal Engineering, pp 61 \(Ed Kari Rissanen, Elsevier 2021\)](#)

## Many uses of starch

*Debajyoti Mahanta and Bhanita Goswami look into the properties of starch and its many uses and applications, in this book chapter.*

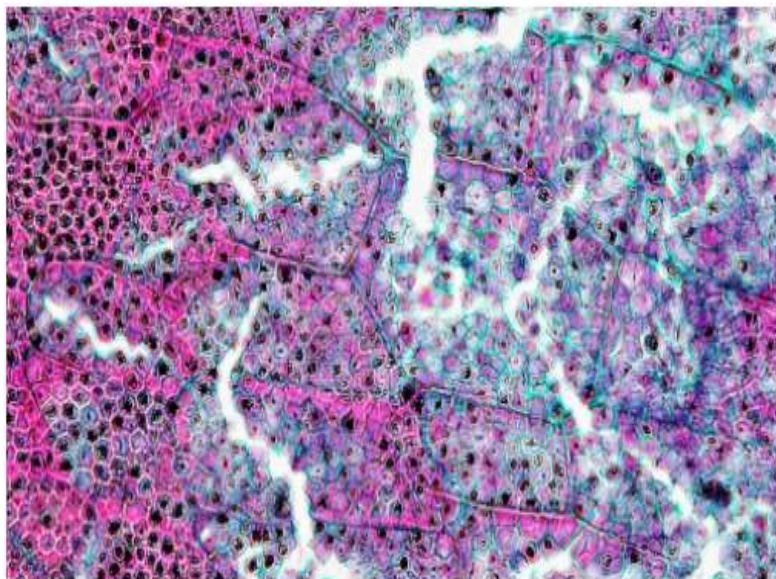


Image : starch in endosperm in embryonic phase of maize seed (from [Wikipedia](#) under CC License)

### Authors

Bhanita Goswami and [Debajyoti Mahanta](#)  
[Department of Chemistry, Gauhati University](#)

### Abstract

Starch, a natural polymer is an important renewable resource which has attracted significant interest for application in various fields including industrial applications. Native starch as well as modified starch is being increasingly used in many technologies and processes owing to their versatility, biodegradability, cost effectiveness, easy usage and availability. These characteristics of starch and its derivatives result a growing interest towards their application in advanced functional materials including typical consumer polymer applications. This book chapter mainly focuses on the properties of starch and its derivatives along with their traditional as well as trending applications in varied areas including food applications, pharmaceutical and cosmetic industrial applications, advanced functional material applications and tissue engineering applications.

### Reference

[in Polysaccharides: Properties and Applications, pp 253 \(Eds Inamuddin, MI Ahamed, R Boddula, and T Altalhi, Scrivener Publishing LLC, Wiley 2021\)](#)



# Flexible supercapacitors

Debjyoti Mahanta and graduate student Sabina Yeasmin looks at the science of flexible supercapacitors in this book chapter. Supercapacitors or ultracapacitors can be used as efficient energy storage devices.

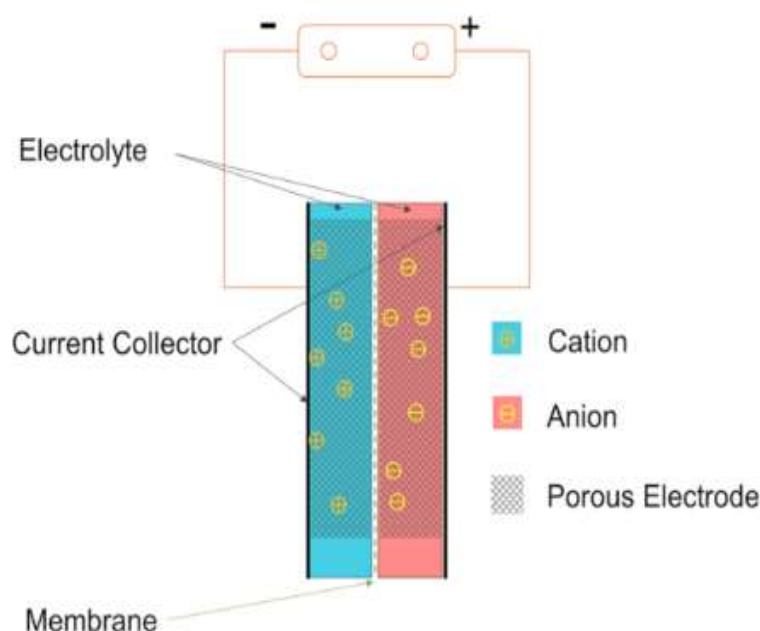


Figure : Schematic representation of a supercapacitor (from [Wikipedia](#) under CC License)

## Authors

Sabina Yeasmin and [Debjyoti Mahanta](#)  
[Department of Chemistry, Gauhati University](#)

## Abstract

The greatest challenge for researchers is to develop an energy storage system that is sustainable, secure, long lasting and most importantly cost effective. Supercapacitors are considered to be an efficient energy storage device because of their high power density, fast charge–discharge, long cycling life and the environment friendly nature. Flexible solid-state supercapacitors are playing the role of pacesetters in energy storage devices in the last few decades owing to the increasing demand of portable and wearable electronics. Here a brief description of flexible supercapacitors, gel electrolytes and flexible electrode substrates has been summarized. In the next section there is a concise outline on innovative cell designs for flexible supercapacitors. Asymmetric supercapacitor is a special category of supercapacitor that makes use of two different active materials for anode and cathode that stores energy via two different storage mechanisms. This study includes an overview of anode and cathode materials that has been used in asymmetric supercapacitors. The challenging fact about asymmetric supercapacitors is to balance the mass of active materials between the electrodes and evaluating the electrochemical performance of the cell. Here is an insight into the massbalancing and performance evaluation in asymmetric supercapacitors.

## Reference

[in Flexible Supercapacitor Nanoarchitectonics, pp 315 \(Eds Inamuddin, MI Ahamed, R Boddula, and T Altalhi, Scrivener Publishing LLC, Wiley, 2021\)](#)

## Two-dimensional thermoelectric materials

*Hemen Kumar Kalita and collaborators discuss about two-dimensional thermoelectric materials in this book chapter.*



Image : Representation of thermoelectric device (from the book cover)

### Authors

Ajay K Kushwaha<sup>1</sup>, [Hemen Kalita](#), Siddhartha Suman<sup>1</sup>, Aditya Bhardwaj<sup>1</sup>, and Rajesh Ghosh  
[Department of Physics, Gauhati University](#)

<sup>1</sup> from another institution

### Abstract

Over recent years, two-dimensional (2D) materials have gained enormous interest as high-performance thermoelectric (TE) materials for efficient and technoeconomic conversion of energy in small-packed power generators and cooling devices. TE devices generate electrical voltage by converting thermal energy across a TE material via the Seebeck effect. The 2D materials, including graphene, graphene oxide (GO), transition metal dichalcogenides (TMDCs), phosphorene, MXene, boron nitride, and other layered materials, are sought to be potential candidates for promising TE devices. The quantum effect and scattering phenomenon in 2D materials are advantageous to design better TE materials with tailorable performance. The 2D materials have shown high TE figure of merit ( $zT$  value; a dimensionless parameter that defines the performance of the TE materials). The study of the quantum effect and thickness-dependent properties of low-dimensional materials led to significant progress in TE performance. Most of the 2D materials are still in the early stages of development for use as TE materials. Moreover, the requirement of facile synthesis methods of 2D materials and simplistic device integration process are the key challenges that require more rigorous investigations to move toward commercialisation.

### Reference

[in \*Thermoelectricity and Advanced Thermoelectric Materials\* \(Eds Ranjan Kumar and Ranber Singh, Woodhead Publishing, Elsevier 2021\)](#)



## Multi Fractal Analysis to help treat attention deficiency

*Eeshankur Saikia and coworkers look into the possibility of treating attention deficiency through multi fractal analysis (MFA) of transcranial direct current stimulation (tDCS) data in this book chapter. tDCS is a form of neuromodulation that uses constant, low direct current delivered via electrodes on the head. It was originally developed to help patients with brain injuries or neuropsychiatric conditions such as major depressive disorder (from [Wikipedia](#)).*

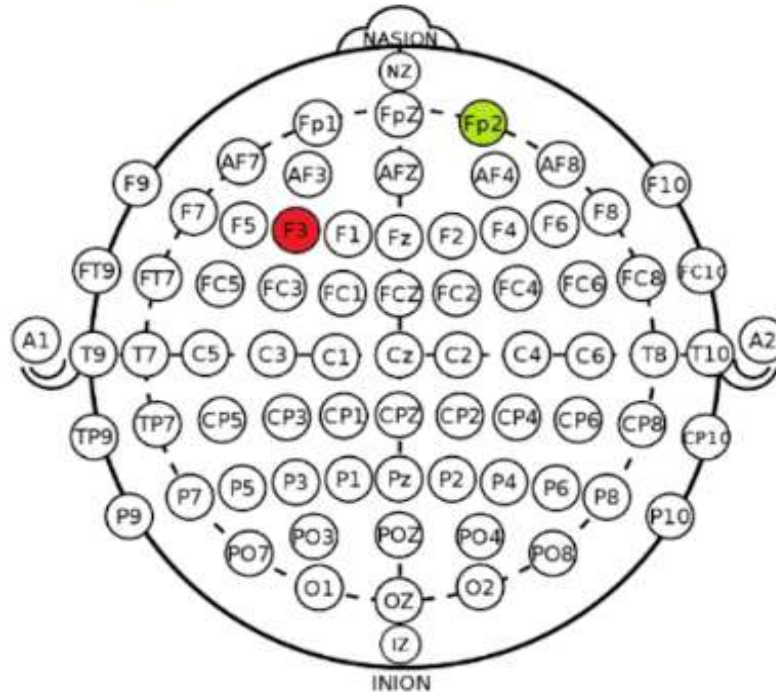


Figure : Schematic of a tDCS montage

### Authors

Pallabjyoti Kakoti, Rissnalin Syiemlieh, and [Eeshankur Saikia](#)  
 Department of Applied Sciences, GU

### Abstract

Anodal transcranial direct current stimulation (tDCS) has been generally recognized as contributing to neuronal excitability and hence increased attention and lower reaction times but cathodal tDCS leads to inhibition of the neurons and leads to Attention deficient and increased reaction times. Here the authors have used Multi Fractal Analysis (MFA) on the EEG data of subjects classified according to age and gender to investigate the detection of attention level, who went through separate EEG sessions for anod Blink (AB) experiment. It is found and reported for the first time that the increase in fractality of the EEG is clearly registered during the tDCS sessions which leads to enhancement of attention and correctness of the AB task which showed during the tDCS session for some subjects and in post-tDCS session for other subjects. Also, age-specific features were found according to the increase or decrease of fractality during post-cathodal tDCS sessions which may lead to not only better understanding and prediction of the attention deficiency in the brain, and thus it is evident from our study that tDCS can be used as an effective tool for prevention and cure of attention deficiency through incorporating the features of MFA into Machine Learning model.

### References

[in Machine Learning for Healthcare Applications, pp 121 \(Eds SN Mohanty, G Nalinipriya, OP Jena, and A Sarkar, Scrivener Publishing, Wiley, 2021\)](#)

## The Anglo-Kuki War

*Doungul Letkhojam Haokip and others explore the Kuki uprising against the British Empire during the First World War in the northeast frontier of India (then the Assam–Burma frontier) in the book [Against the Empire: Polity, Economy and Culture during the Anglo-Kuki War, 1917-1919](#), of which he is one of the editors. In a chapter in the book, Dr Hokip studies the logistics rendered to the combat forces during the war.*



Image : Footage of the war

### Editors & Author

Ngamjahao Kipgen<sup>1</sup> and [Doungul Letkhojam Haokip](#)  
[Department of History, GU](#)

<sup>1</sup>*from another institution*

### Abstract

This book explores the Kuki uprising against the British Empire during the First World War in the northeast frontier of India (then the Assam–Burma frontier). It sheds light on how the three-year war (1917–1919), spanning over 6,000 square miles, is crucial to understanding the present-day Northeast India. In this book, various authors examine several aspects of the Anglo-Kuki War, which had far-reaching consequences for the indigenous Kuki population, including economy, politics, identity, indigenous culture and belief systems, and traditional institutions during and after the First World War itself. Different chapters also highlight finer themes such as the role of the chiefs and war councils, symbols of communication, indigenous interpretation of the war, remembrance, and other policies which continued to confront the Kuki communities. Moving away from colonial ethnographies, the volume taps on a variety of sources – from civilisational discourse to indigenous readings of the war, from tour diaries to oral accounts – meshing together the primitive with the modern, the tribal and the settled.

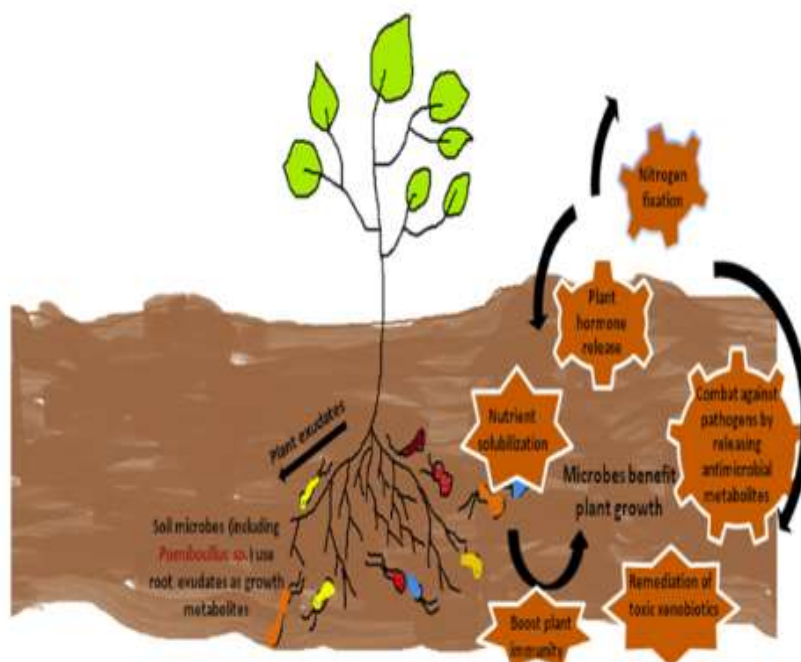
### References

[Against the Empire \(Routledge India 2020\)](#)  
[in Against the Empire, pp 93 \(Eds N Kipgen and DL Haokip, Routledge India 2020\)](#)



# Paenibacillus

Hemen Deka and his collaborator provide an in-depth review of *Paenibacillus* in this book chapter. *Paenibacillus* is a genus of facultative anaerobic, endospore-forming bacteria, originally included within the genus *Bacillus* and then reclassified as a separate genus in 1993 (from [Wikipedia](#)).



Schematic : Soil rhizospheric microorganisms and plant growth promotion

## Authors

Rupshikha Patowary<sup>1</sup> and [Hemen Deka](#)  
[Department of Botany, Gauhati University](#)

<sup>1</sup> from another institution

## Abstract

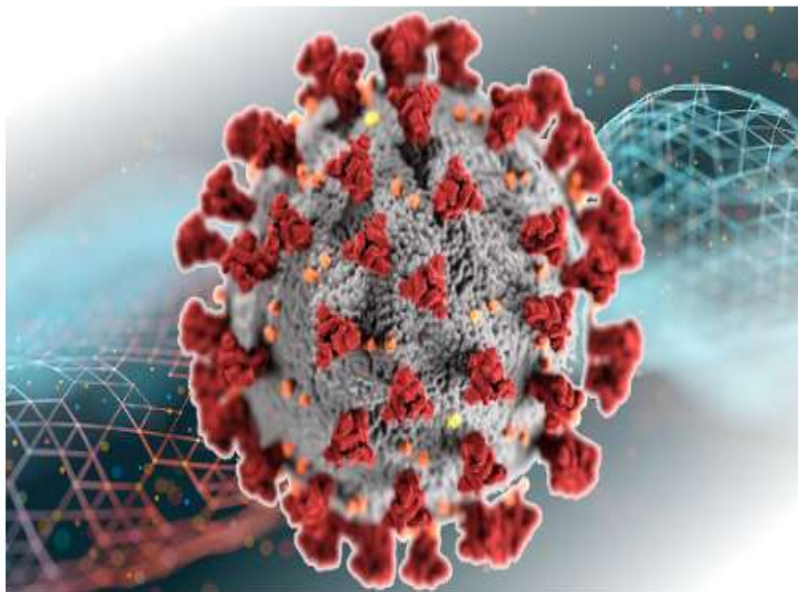
Microbes play an important role for the development of biotechnological products and processes. Therefore, at present, more emphasis has been given for discovery of new microbes and to find out their application potential in day to day life. The exploration of microbial diversity has been recognized as the major driving forces for the development of biotechnological products and processes. Perhaps, the microbial world is the largest unexplored reservoir of biodiversity that exists in diverse ecological niches, including extreme environments. Exploration of microbial diversity holds great promise because of the role of microbes in nutrient cycling, environmental detoxification, and novel metabolic abilities in pharmaceuticals and industrial processes. More recently the members of *Paenibacillus* have gained more attention primarily due to their great biotechnological potential in bioremediation of xenobiotics and sustainable agriculture.

## Reference

[in Beneficial Microbes in Agro-Ecology: Bacteria and Fungi](#), pp 339 (Eds N Amaresan et. al., Elsevier, Academic Press, 2020)

# Nanotechnology and COVID-19

*Hemen Kumar Kalita and collaborators discuss how nanotechnology can be useful in detection and prevention of COVID-19 disease in this book chapter.*



## Authors

Ajay K Kushwaha<sup>1</sup>, [Hemen Kalita](#), Aditya Bhardwaj<sup>1</sup>, Siddhartha Suman<sup>1</sup>, Biswajit Dehingia, and Rajneesh Kumar Mishra<sup>1</sup>  
[Department of Physics, Gauhati University.](#)

<sup>1</sup> from other institutions

## Abstract

Over the years, due to climate change, developing cities, industrial transformation, excessive farming, food habits, and ease of traveling have increased the chances of spreading of a pathogen in case of any pandemic. Scientists are trying to devise strategies to stop or mitigate any potential outbreak of any unknown virus: SARS-CoV-2, an invisible virus, a profound way to distort human lifestyle globally, causing COVID-19. Herein, the chapter discusses the advancements in nanotechnological solutions for the detection and prevention of COVID-19. The structure, characteristics, detection methods, possible mechanisms, sensors, and portable test kits of the SARS-CoV-2 virus are reviewed. Various nanomaterials-based formulations and promising approaches for the detection and clinical diagnosis of SARS-CoV-2 infections are carefully summarised. The authors discuss how nanotechnology can be used as a tool to alleviate the SARS-CoV-2 virus and explore the applications of nanomaterials for antiviral, antifungal coatings on personal protective equipment for protection. Studies revealed that there is a broad scope to develop various nanotechnology-based solutions to combat the invisible enemy of humankind.

## Reference

[Integrated Risk of Pandemic: Covid-19 Impacts, Resilience and Recommendations \(Springer 2020\)](#)



# Sterile neutrino and neutrino oscillation

Kalpana Bora and Neelakshi Sarma discuss the role of sterile neutrino in neutrino oscillation in this book chapter. In physics, sterile neutrinos (or inert neutrinos) are hypothetical particles that interact only via gravity and do not interact via any of the fundamental interactions.

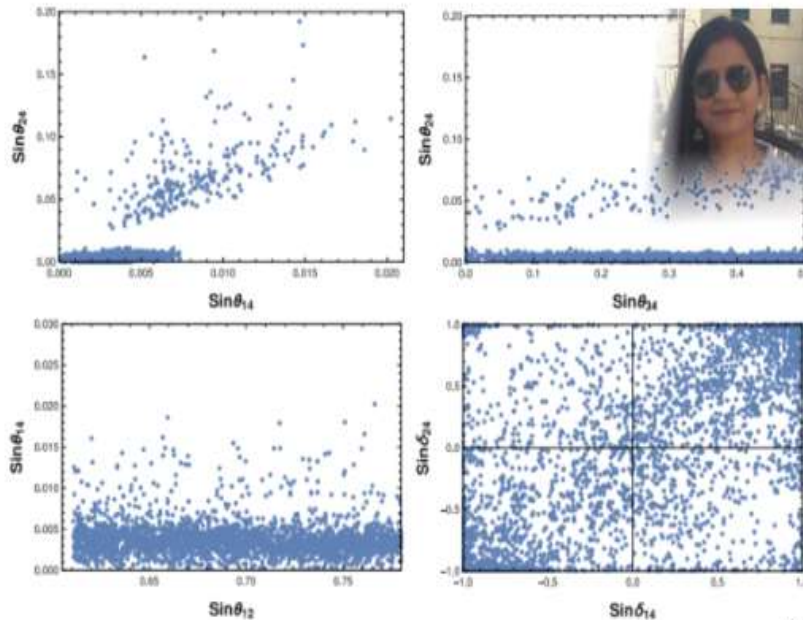


Image : Neutrino oscillation parameters

## Authors

[Kalpana Bora](#) and Neelakshi Sarma  
[Department of Physics, Gauhati University](#)

## Abstract

In this work, the authors review the status of evidences in support of existence of sterile neutrinos. Then, after revisiting one of the most minimal seesaw (MES) model that gives rise to a  $(3 + 1)$  light neutrino mass matrix, they include  $A_4$  flavour symmetry in the theory. Considering the generic vacuum alignments of  $A_4$  triplet flavons, they classify the resulting mass matrices based on their textures, and predict interesting correlations between neutrino oscillation in the allowed cases. They also find that all of these allowed cases prefer normal hierarchical pattern of light neutrino masses over inverted hierarchy.

## Reference

[Workshop on Frontiers in High Energy Physics, Springer Proceedings in Physics 248 \(2020\)](#)



SAGE STUDIES ON INDIA'S NORTH EAST

# **HINDUTVA REGIME IN ASSAM**

Saffron in the Rainbow

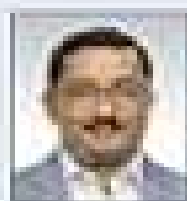
**Akhil Ranjan Dutta**





*Hinduva Regime in Assam: Saffron in the Rainbow* analyses the Bharatiya Janata Party's (BJP) strategy of appropriating cultural resources in Assam while pursuing the Hinduva agenda. In Assam, where numerous ethnic and regional political outfits have registered their electoral presence, the 'Rainbow Alliance' emerged as the dominant strategic tool for BJP in its electoral battles. The book studies how BJP has capitalised on people's attachment to their ethno-regional cultures and has successfully co-opted and 'saffronised' the 'Rainbow' by bringing together diverse ethnic groups into its fold. Scrutinising electoral strategies, BJP's victories in 2014, 2016 and 2019, and the efforts towards dismantling consensus around the National Register of Citizens (NRC) by enacting the Citizenship Amendment Act (CAA), the book provides a holistic view of the steady 'saffronisation'. It also critically investigates BJP's populist development agenda.

From the Rashtriya Swayamsevak Sangh's (RSS) grassroots work to the government's policy initiatives, the book analyses the regime's performance and ideological pursuits in depth. It highlights how BJP's strategies in Assam are unique in some ways and how similar strategies can be seen elsewhere in India.



**Anand Ranjan Dutta** is Professor in the Department of Political Science, Gauhati University, Assam, India.



## The Languages of Assam

(Volume 5, Part 2)

*Volume Editors: Bibha Bharali & Banani Chakravarty*

This volume discusses some interesting features of the languages spoken in the valleys, hills and terrains of Assam. It discusses features of Scheduled, Non-scheduled, and other languages of the state. The volume lists how these languages are in use in day-to-day life of the people there. It also includes folktales and folk songs to tell the reader about the rich culture of Assam.

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# Traversing Diverse Terrains: Interview with Abhishek Majumdar

[criticalstages.org/2023/traversing-diverse-terrains-interview-with-abhishek-majumdar/](https://criticalstages.org/2023/traversing-diverse-terrains-interview-with-abhishek-majumdar/)

by Asha Kuthari Chaudhuri

May 16, 2023

by Asha Kuthari Chaudhuri\*



Abhishek Majumdar. Photo: MD Pallavi

Abhishek Majumdar's theatre carries the weight of multiple languages, regions, philosophies, forms, themes and colors that immediately call to mind the sheer diversity of the Indian theatrical landscape. And beyond. That his work is sometimes deeply embedded in the Indian ethos and at others, involved in global discourses is merely the mark of what it means to be a living playwright and theatre maker who is deeply committed to consistently pushing the boundaries of the theatre both inwards and outwards. He confronts perplexing political and environmental issues, ruffling feathers across the spectrum and throwing up important new ways of understanding our world. When the pandemic closed down the theatres, he joined a food, oxygen and healthcare distribution network while also writing for the digital stage to highlight those very issues.

Abhishek Majumdar is the recipient of the Charles Wallace Fellowship, the Inlaks scholarship among numerous other awards, and trained at LISPA (UK). He is an Associate Professor and Program Head in the Theatre Program at NYU, Abu Dhabi while also creating work, teaching and acting as dramaturg for young writers in India. But like most theatre people, he travels and produces work around the world, collaborating and cutting across liminal spaces to make work and meaning – meaningful work.

Golam Jalal Ahammed  
Roghieh Hajiboland *Editors*

# Arbuscular Mycorrhizal Fungi and Higher Plants

Fundamentals and Applications

 Springer



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## Chapter 9

# Arbuscular Mycorrhizal Fungi (AMF)-Mediated Control of Foliar Fungal Diseases



Priyakshi Kashyap, Indrani Sharma, Sampurna Kashyap, and **Niraj** Agarwala

**Abstract** Plants witness a variety of disease incidences throughout their life, ultimately resulting in reduced plant growth and productivity. Climate change or human interventions have aggravated the incidences of various plant diseases, among which foliar fungal diseases are serious threats. Arbuscular mycorrhizal fungi (AMF) are a mutualistic group of organisms that play a significant role in enhancing plant growth and resilience under varied environmental circumstances. Moreover, it is well established that AMF confers tolerance against several foliar fungal diseases. This chapter highlights how fungal foliar diseases affect plant health and the various roles of AMF in providing resistance to different crop plants. In addition, AMF-mediated alterations in the root system architecture (RSA), modulation of reactive oxygen species (ROS), and reinforcement of the physical barrier that prevents pathogen invasion and establishment have been discussed in detail. Furthermore, the intricate cross talk between AMF and phytohormones or plant metabolites has also been explored. Overall, harnessing the potential of AMF in imparting tolerance against foliar fungal diseases might reduce the reliance on chemical fungicides, thereby introducing an environment-friendly approach for plant protection.

**Keywords** Arbuscular mycorrhizal fungi · Foliar fungal diseases · Plant growth-promoting rhizobacteria · Defense responses · Root exudation · Rhizosphere niche



# Chapter 1 - Status of impact of abiotic stresses on global agriculture

[Shima Nehra<sup>1,2,\\*</sup>](#), [Gopal Kalwan<sup>3,4,\\*</sup>](#), [Ritu Gill<sup>1,\\*</sup>](#), [Kiran Nehra<sup>2</sup>](#), [Niraj Agarwala<sup>5</sup>](#),  
[Radeep Kumar Jain<sup>3</sup>](#), [M. Naeem<sup>5</sup>](#), [Narendra Tuteja<sup>7</sup>](#), [Ramesh Namdeo Pudake<sup>8</sup>](#),  
[Harvajeet Singh Gill<sup>1,\\*</sup>](#)

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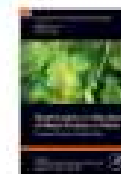
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## Abstract

Global agriculture is facing the wrath of climatic stresses, which significantly impact global food production and demand. Continuously changing global climatic conditions leading to prolonged climate extremes like flooding and drought, extreme precipitation, brusque temperature fluctuations, soil salinization, land degradation and decreased soil fertility, soil compaction, decreased microbial diversity, war, and war-like situations pose significant yield penalties on global agriculture, and therefore puts food security at risk. The prolonged intensive use of agrochemicals (chemical fertilizers and pesticides) globally adds heavy metals (Cr, Cd, Hg, Pb, Cu, and As) to the agriculturally suitable land. As the population is mounting, excessive exploitation of natural resources occurs, and unsustainable agricultural practices putting extra burden on lands and soil. Approximately, 90% of the arable land is at high risk because of one or more abiotic stresses. Abiotic stresses have significant potential to cause 51%–92% crop yield loss in



## 17 - *Piriformospora indica* (Serendipita indica): potential tool for alleviation of heavy metal toxicity in plants

Ritu Sharaya<sup>1</sup>, Deepa<sup>1</sup>, Ashima Nehra<sup>1</sup>, Gopal Kalwan<sup>2</sup>, Niraj Agarwala<sup>3</sup>, Nafees A. Khan<sup>4</sup>,  
Narendra Tuteja<sup>5</sup>, Ritu Gill<sup>6</sup>, Sarvajeet Singh Gill<sup>7</sup>

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### Abstract

Heavy metals are one of the major causes of environmental pollution, which has been increasing rapidly due to anthropogenic activities. It has become a matter of concern for human beings themselves. Higher acquisition of heavy metals affects crop productivity and quality. Plant's ability to absorb the metals from the soil is determined by the physiological and biochemical pathways. Plants accumulate heavy metals from the soil through their roots and transport and deposit them in several tissues based on their affinity to the metal. The heavy metal uptake by the roots is decided by the availability of





## 5 - Exogenous application of biostimulants and commercial utilization

Deepa<sup>1 \*</sup>, Punam Kundu<sup>1 \*</sup>, Ashima Nehra<sup>1</sup>, Gopal Kalwan<sup>2</sup>, Niraj Agarwala<sup>3</sup>, Nafees A. Khan<sup>4</sup>, Narendra Tuteja<sup>5</sup>, Ritu Gill<sup>6</sup>, Sarvajeet Singh Gill<sup>7</sup>

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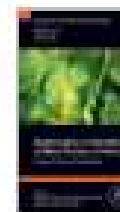
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### Abstract

Biostimulants are a growing field in agriculture that hold the potential to increase crop yields, improve plant growth and resilience, and reduce the environmental impact of farming practices. Biostimulants contain a variety of substances such as humic and fulvic acids, amino acids, and seaweed extracts that stimulate plant growth and improve nutrient uptake, stress tolerance, and disease resistance. It has been reported that the projected growth of India's biostimulants market is \$266.58 million in 2022 which is expected to grow \$734.13 million by 2029

(<https://www.fortunebusinessinsights.com/india-biostimulants-market-106785>). The global biostimulants market size was valued at \$2.6 billion in 2022 and is anticipated to



## 16 - Microbial symbionts for alleviation of heavy metal toxicity in crop plants

[Sampurna Kashyap](#), [Ramen Barmar](#), [Manabendra Nath](#), [Niraj Agarwala](#)

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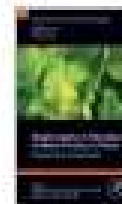
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### Abstract

Due to various anthropogenic activities, crop plants are witnessing the havoc of heavy metal toxicity. From various sources, the heavy metals get accumulated in the soil and are taken up by the plants if they are grown in heavy metal-contaminated soil. Due to the accumulation of heavy metals, the metabolism of the plants gets affected which leads to yield penalty. Biostimulants are recently emerging as an effective means for alleviating heavy metal toxicity in crop plants. There are two main categories of biostimulants namely, nonmicrobial biostimulants and microbial biostimulants. The microbial biostimulants help in remediating heavy metal stress from crop plants by activating various physiological and biochemical mechanisms. Microbial biostimulants have several advantages over nonmicrobial biostimulants due to their eco-friendly nature and their



## 23 - Biostimulants in the alleviation of metal toxicity: conclusion and future perspective

Ritu Gill<sup>1</sup>, Ashima Nehra<sup>2</sup>, Niraj Agarwala<sup>3</sup>, Nafees A. Khan<sup>4</sup>, Narendra Tuteja<sup>5</sup>,  
Sarvajeet Singh Gill<sup>6</sup>

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### Abstract

Heavy metals are toxic for the growth and development of plants and can accumulate in the soil, leading to soil and water contamination. Biostimulants have been shown to alleviate heavy metal stress in plants through a variety of mechanisms, including enhancing plant nutrient uptake, improving antioxidant defense mechanisms, and increasing the activity of plant growth-promoting microorganisms in the soil. Seaweed extract is rich in bioactive compounds such as polysaccharides, amino acids, and plant growth hormones that can enhance plant growth and stress tolerance. Research has revealed that seaweed extract can reduce heavy metal toxicity in plants by increasing plant nutrient uptake, improving photosynthesis, and enhancing antioxidant defence.





## 1 - Biostimulants in the alleviation of metal toxicity: an overview

Deepa<sup>1</sup>, Ritu Sharaya<sup>1</sup>, Ashima Nehra<sup>1</sup>, Niraj Agarwala<sup>2</sup>, Nafees A. Khan<sup>3</sup>, Narendra Tuteja<sup>4</sup>,  
Ritu Gill<sup>5</sup>, Sarvajeet Singh Gill<sup>6</sup>

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### Abstract

Heavy metal contamination of soil poses a serious threat to soil quality and crop productivity worldwide. Heavy metals in the environment affect all life forms, whereas lighter metals could be toxic, depending on their accumulation in body tissues. Anthropogenic activities have subsidized their discharge from natural sources to water bodies, atmosphere, and soil, consequently, creating a polluted environment for life forms. It becomes imperative to support and strengthen plant performance in contaminated environment for safe and healthy food production. To date, many scientific methods have been introduced to remediate heavy metal toxicity in plants, predominantly by applying biostimulants. Biostimulants encourage the existing chemical

M. Naeem  
Juan Francisco Jimenez Bremont  
Abid Ali Ansari  
Sarvajeet Singh Gill *Editors*

# Agrochemicals in Soil and Environment

Impacts and Remediation

 Springer

# ***Aspergillus*-Mediated Bioremediation of Agrochemicals: Current Progress and Future Perspectives**

Chapter | First Online: 29 June 2022

pp 503–533 | [Cite this chapter](#)

[Priyakshi Kashyap](#), [Bina Agarwal](#) & [Niraj Agarwala](#) 

 647 Accesses

## **Abstract**

In modern agriculture, several synthetic chemicals are used to achieve higher crop production and to mitigate biotic stresses in plants. Crop productivity has increased over the last few decades as a result of the use of newer technologies and stress control measures but due to excessive use of agrochemicals to tackle the problem of crop damage during the pre- and post-harvest period, it has become a significant threat to the productivity and sustainability of the ecosystem. Bioremediation technique has been used for



# Taxonomy, Botany and Physiology

Authors: B. Gaaliche , D. Narzary, M. Ben Mimoun, A. Sarkhosh [AUTHORS INFO & AFFILIATIONS](#)

Publication: [The Fig: Botany, Production and Uses](#)

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## Abstract

This chapter focuses on the botany and physiology of the horticulturally important fig (*Ficus carica*) species. Through understanding of its reproductive complexity and developmental biology, complete genome sequencing could place the fig as a model plant in horticulture and evolutionary biology. And, in Mediterranean regions and Western Asia, where both cultivated and semiwild figs are found, a systematic germplasm collection of the traditional fig cultivars and wild relatives is imperative for proper germplasm management and conservation.

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# Plant–Microbe Interactions in Combating Abiotic Stresses

Namrata Konwar, Khomdram Niren Singh, and Diganta Narzary 

## Abstract

There is a significant decline in crop yield, quality of crops and soil fertility worldwide due to increased biotic and abiotic stresses that are either induced naturally or due to anthropogenic factors such as rapid urbanization and industrialization. Interaction of plants with several beneficial microbes such as Plant Growth-Promoting Microbes (PGPM) comprising of actinomycetes, rhizospheric bacteria, and fungi help the plants to survive during abiotic stress conditions such as extreme temperatures (very low or very high temperature), flood or drought conditions, high salinity stress, heavy metal stress, nutrient deficiency and oxidative damages. Abiotic stresses harm plant growth, cellular morphology and physiology through obstruction in cellular pathways or gene regulation inside the cell. These microbes employ stress tolerance mechanisms in plants, such as the production of anti-oxidants, exopolysaccharides (EPS), phytohormones, osmolytes, formation of biofilms and siderophores, through various biosynthetic pathways. Here, in this chapter, we review recent findings in successful employment of microbial inoculation that induce abiotic stress tolerance in crop plants and study the role of bioactive metabolites liberated by microbes in association with plants which may help design strategies and tools for the development of improved and efficient microbial inoculant for optimizing plant growth in crop fields under adverse abiotic stressed conditions.

## Keywords

Abiotic stress • Bioremediation • Mycoremediation • Plant growth-promoting microbe • Stress • Stress tolerant mechanism

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Assam, India  
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## Abbreviations

ABA	Abscissic acid
ACC	1-Aminocyclopropane-1-carboxylate
APX	Ascorbate peroxidase
CAT	Catalase
CK	Cytokinin
DHAR	Dehydroascorbate reductase
EPS	Exopolysaccharides
GSH	Glutathione
GP	Guaiacol peroxidase
GPX	Glutathione peroxidase
GR	Glutathione reductase
HSP	Heat-shock proteins
IAA	Indole-3-acetic acid
JA	Jasmonic acid
MDA	Malondialdehyde
MDHAR	Monodehydroascorbate reductase
Pas	Polyamines
PGPB	Plant growth-promoting bacteria
PGPM	Plant growth-promoting microbes
PGPR	Plant growth-promoting rhizobacteria
POD	Peroxidase
ROS	Reactive oxygen species
MAP	Mitogen-activated proteins
SA	Salicylic acid
SOD	Superoxide dismutase

## 1 Introduction

There is a sharp decline in crop yield, quality of crops and soil fertility worldwide due to increased biotic and abiotic stresses. Biotic and abiotic stresses can be induced either naturally or by anthropogenic factors. Rapid urbanization and industrialization without sufficient regulations related to

# Taxonomy, botany and physiology.

Authors: D. Narzary , N. Yazdanbakhsh, T. S. Rana | [AUTHORS INFO & AFFILIATIONS](#)

Publication: [The pomegranate: botany, production and uses](#)

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## Abstract

This chapter provides information on the taxonomy and systematics, phylogeny, botany, juvenility, phenology, reproduction, plant development, and physiology of pomegranate.

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# Plant–Microbe Interactions in Combating Abiotic Stresses

Namrata Konwar, Khomdram Niren Singh, and Diganita Narzary

## Abstract

There is a significant decline in crop yield, quality of crops and soil fertility worldwide due to increased biotic and abiotic stresses that are either induced naturally or due to anthropogenic factors such as rapid urbanization and industrialization. Interaction of plants with several beneficial microbes such as Plant Growth-Promoting Microbes (PGPM) comprising of actinomycetes, rhizospheric bacteria, and fungi help the plants to survive during abiotic stress conditions such as extreme temperatures (very low or very high temperature), flood or drought conditions, high salinity stress, heavy metal stress, nutrient deficiency and oxidative damages. Abiotic stresses harm plant growth, cellular morphology and physiology through obstruction in cellular pathways or gene regulation inside the cell. These microbes employ stress tolerance mechanisms in plants, such as the production of anti-oxidants, exopolysaccharides (EPS), phytohormones, osmolytes, formation of biofilms and siderophores, through various biosynthetic pathways. Here, in this chapter, we review recent findings in successful employment of microbial inoculation that induce abiotic stress tolerance in crop plants and study the role of bioactive metabolites liberated by microbes in association with plants which may help design strategies and tools for the development of improved and efficient microbial inoculum for optimizing plant growth in crop fields under adverse abiotic stressed conditions.

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e-mail: d\_narzary@gauhati.ac.in

## Abbreviations

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## 1 Introduction

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# Harnessing the Power of Microbes to Overcome Heavy Metal Stress in Crop Plants

Khomdram Niren Singh and Diganta Narzary

## Abstract

The declining of crop productions due to various biotic and abiotic factors is evident these days. Among the various factors, heavy metal stress is one of the major abiotic factors which is responsible for lower crop productivity that needs to be addressed and resolved. There are a few ways to overcome heavy metal stress in crop plants, which require appropriate selection for effective results. Many strains of microbes (bacteria, fungi, algae) have intrinsic properties to either absorb, uptake, or change the chemical properties of metals available to the plants. There are several reports that claim the effective use of microbes in mitigation/bioremediation of heavy metal contamination in soil and water. Being microbial treatment of the heavy metal contaminated soil is one of the best options available in terms of their cost-effectiveness and environmental friendliness in overcoming metal stress in crop plants. Therefore, in this chapter, we have highlighted and discussed the various sources of heavy metal contamination in crop fields, their toxic effects on crop plants, the various mechanism adopted by plants to resist the toxic effects of heavy metals, and the microbial potential in bioremediation of heavy metals that include the heavy metal resistance and uptake mechanism in microbes, their effective use in bioremediation, and finally, we have discussed the application of advanced technologies such as genetic engineering and omics technology in the field of microbiology for their potential use in the bioremediation of heavy metals.

## Keywords

Algae • Bacteria • Crop plant • Fungi • Metal stress • Soil bioremediation

## Abbreviations

ABC	ATP-Binding Cassette
ACC	1-Aminocyclopropane-1-Carboxylate
AMF	Arbuscular Mycorrhizal Fungi
ASA	Ascorbate
ATM	ABC Transporters of the Mitochondria
CAX	Calcium Cation Antiporter
CDF	Cation Diffusion Facilitator
COPT	Copper Transporter
CRISPR	Clustered Regularly Interspaced Short Palindromic Repeats
GEMs	Genetically Engineered Microorganisms
GMMs	Genetically Modified Microorganisms
GRFC	Global Report on Food Crises
GSH	Glutathione
HM	Heavy Metal
IRT	Iron-regulated Transporter
MT	Metallothionein
PCS	Phytochelatin Synthase
PCs	Phytochelatins
PGPR	Plant Growth Promoting Rhizobacteria
ROS	Reactive Oxygen Species
SOD	Superoxide Dismutase
V-ATPase	Vacuolar Proton-ATPase
V-PPase	Vacuolar Proton-Pyrophosphatase
ZRT	Zinc-regulated Transporter

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781014, India  
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# Analyzing Copper Dependent Growth Behaviors in *Anabaena azollae* Strasburger, an Autochthonous Cyanobacterial Species of Assam

Kalita, Nilamjyoti and Boruah, Bishmita and Bhattacharjee, Shaswatee and Kalita, Himamani and Bora, Garima and Baruah, Partha Pratim (2024) *Analyzing Copper Dependent Growth Behaviors in Anabaena azollae* Strasburger, an Autochthonous Cyanobacterial Species of Assam. In: Research Perspectives of Microbiology and Biotechnology Vol. 1. B P International, pp. 43-53. ISBN 978-81-971580-3-2

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## Abstract

Copper (Cu) is considered as an essential micronutrient that is required in minute quantity for proper functioning of physiochemical reactions in the body of an organism. This microelement plays a significant role during growth and development in plants through different cellular processes. Although, if present in higher quantities can result in toxic effects. Current study was undertaken to view the effect of different ppm concentrations of Cu (II) ions upon the growth and biochemical parameters of *Anabaena azollae*. Results have disclosed that exposure to a high concentration of Cu causes an evidential effect in growth and biochemical parameters in the test organism.

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## Chapter 3 - Microbial conversion of biomass to value-added chemicals

Jintu Rabha, Sashi Prava Devi, Sukanya Das, Niranjana Roy, Dhruva Kumar Jha

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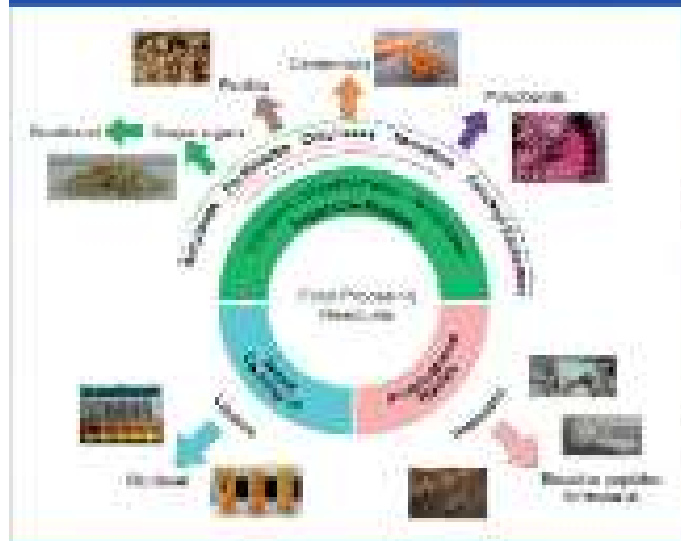
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### Abstract

Plant biomass refers to dry matter generated by plants utilizing atmospheric carbon dioxide and water in the presence of sunlight through the process of photosynthesis. Structurally, biomass is made up of a complex matrix, composed of cellulose wrapped around by a dense structure consisting of other polymers like hemicellulose, lignin, pectin, proteins, glycerides, etc. The lignocellulosic wastes mainly include residues generated by agricultural, industrial, and forest sectors. An approximate 140 Gt of biomass wastes are generated annually throughout the world. However, only a small amount of this biomass is valorized as feedstock for industrial applications and energy generation (in developed countries). In developing countries, however, a significant portion of this resource is not utilized but left to decompose or are burnt. Nonetheless, because of its abundance, renewability, and cost-effective characteristics, the lignocellulosic biomass is recognized as an effective alternative substrate for the production of fuels and industrially important products. Structural complexity of the lignocellulose makes it inaccessible for processing and thus, the release of fermentable sugars is difficult. Innovative valorization of the naturally abundant and renewable biomass is of great importance in the pursuit of a biobased economy and sustainable



# Value-Addition in Agri-Food Industry Waste Through Enzyme Technology



Edited by  
**Mohammed Kuddus**  
**Pramod W Ramteke**



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# Microbial conversion of biomass to value-added chemicals

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### 3.1 Introduction

The global population is increasing at a tremendous rate in recent years and will continue to do so. Consequently, there is increasing demand for food and other basic resources that have given rise to the intensification of agricultural and industrial activities. Correspondingly, with rapid global urbanization and the rising demands, alternative energy sources and feedstock materials are required to meet sustainable development goals (SDGs). In the present scenario, nonrenewable fossil resources, mainly coal and petroleum account for the production of the majority of essential fuels and essential chemicals. However, in contrast to diminishing fossil resources, exigency for energy and chemicals is continuously increasing. Extensive consumption of nonrenewable resources has moreover, also led to the generation of large amounts of greenhouse gases contributing to climate change (Zhang et al., 2017). Increasing demand for

in the field for decomposition or burnt; consequently, this discarded biomass can have adverse environmental impacts (Hills et al., 2020). Irrefutably, climate change, energy, and food security are some of the most pressing issues that globally decide the search for a substitute feedstock for the production of biofuels, biochemicals, and bioenergy (Ahorsu et al., 2018). The development of suitable strategies for the sustainable use of these resources and consequently protecting the environment is the need of the hour.

We can solve two problems, that is, solving some pressing environmental issues due to improper use of these wastes and getting value-added products from them when the easily and abundantly available agricultural biomass residues are used as feedstock for generation of chemicals. Availability of only a few and less efficient procedures (mainly categorized under thermochemical and chemical processes) for the utilization of the otherwise abundant lignocellulosic

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## Chapter 3 - Microbial conversion of biomass to value-added chemicals

Jintu Rabha, Sashi Prava Devi, Sukanya Das, Niranjana Roy, Dhruva Kumar Jha

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### Abstract

Plant biomass refers to dry matter generated by plants utilizing atmospheric carbon dioxide and water in the presence of sunlight through the process of photosynthesis. Structurally, biomass is made up of a complex matrix, composed of cellulose wrapped around by a dense structure consisting of other polymers like hemicellulose, lignin, pectin, proteins, glycerides, etc. The lignocellulosic wastes mainly include residues generated by agricultural, industrial, and forest sectors. An approximate 140 Gt of biomass wastes are generated annually throughout the world. However, only a small amount of this biomass is valorized as feedstock for industrial applications and energy generation (in developed countries). In developing countries, however, a significant portion of this resource is not utilized but left to decompose or are burnt. Nonetheless, because of its abundance, renewability, and cost-effective characteristics, the lignocellulosic biomass is recognized as an effective alternative substrate for the production of fuels and industrially important products. Structural complexity of the lignocellulose makes it inaccessible for processing and thus, the release of fermentable sugars is difficult. Innovative valorization of the naturally abundant and renewable biomass is of great importance in the pursuit of a biobased economy and sustainable



## Chapter 17 - Ecofriendly utilization of lignocellulosic wastes: mushroom cultivation and value addition

Khomdram Bijoya Devi, Rahul Malakar, Amrit Kumar, Nilam Sarma, Dhruva Kumar Jha

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### Abstract

Lignocellulosic wastes are low-cost, renewable, plentiful, and are a good natural resource for bioenergy and many other useful products. The cost of conversion is high; therefore, scientists are trying to develop cost-effective methods to transform these tough to degrade raw materials into value-added products having different applications. Large amounts of lignocellulosic wastes are produced as residues from agriculture and agroforestry sectors. The global annual generation of lignocellulosic wastes is in the order of 140 gigatons and presents significant management problems. They are generally burnt or left as garbage leading to air pollution and deterioration of soil and water quality. Value addition of these wastes using cost-effective techniques would lead to better utilization of these wastes. The bioconversion of lignocellulosic wastes through mushroom cultivation offers an ecologically sound alternative to convert these wastes into nutrient-rich foods and thus reduce pollution. Mushrooms are good sources of foods

# Chapter 17 - Microbial biodesulfurization: a sustainable technology for refining fossil fuels

Mainu Kalita<sup>1,2</sup>, Prashanth A. Sangannavar<sup>3</sup>, Mahananda Chutia<sup>1</sup>, Dhruva Kumar Jha<sup>2</sup>,  
Kutala Sathyanarayana<sup>3</sup>, Jalaja S. Kumar<sup>1</sup>, Gangavarapu Subrahmanyam<sup>1,4</sup>

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## Abstract

Combustion of fossil fuels with high levels of sulfur compounds such as dibenzothiophene and their alkylated derivatives leads to severe environmental pollution. The reduction of sulfur emissions from fossil fuels is one of the strict regulations imposed on petroleum refineries by environmental legislative councils of developed countries. The traditional hydrodesulfurization (HDS) process employed by oil industries demands extreme conditions like high pressure, temperature, etc., but is expensive and inefficient in removing recalcitrant polyaromatic sulfur hydrocarbons. In the recent past, biodesulfurization (BDS) using microorganisms to reduce the sulfur content in fuels has gained a lot of attention. This process stands at an advantage from HDS as it is cost-effective, eco-friendly, and requires ambient pressure and temperature

Raghvendra Pratap Singh  
Geetanjali Manchanda  
Kaushik Bhattacharjee  
Hovik Panosyan *Editors*

# Microbes in Microbial Communities

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# Metallotolerant Microorganisms and Microbe-Assisted Phytoremediation for a Sustainable Clean Environment

Chapter | First Online: 01 January 2022

pp 307–336 | [Cite this chapter](#)

[Dina Barman](#) & [Dhruva Kumar Jha](#) 

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## Abstract

Both natural and anthropogenic activities have upsurged the accumulation of heavy metals in the environment. These pollutants affect the natural ecosystems, and on entering the food chain, they become hazardous to public health. In the polluted soil, where survival of plants and microbes is difficult, metallotolerant microbes can thrive by tolerating the toxic effects of heavy metals. For that, they use diverse survival mechanisms which also assist them to perform bioremediation. In comparison to conventional and physical methods of conversion of the toxic effect of metals to its non-toxic form, bioremediation is a more effective method for retrieving the metal-contaminated environments and convert the degraded area into green covers. Considering the importance, this book chapter sheds light on the mechanism, which encourages the metallotolerant microbes thriving in these metal-rich environments and performs

Tulasi Satyanarayana  
Subrata Kumar Das  
Bhavdish Narain Johri *Editors*

# Microbial Diversity in Ecosystem Sustainability and Biotechnological Applications

Volume 2. Soil & Agroecosystems

 Springer

# Cave Microbiome for Human Welfare

Chapter | First Online: 07 September 2019

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[Subhro Banerjee](#), [D. K. Jha](#) & [S. R. Joshi](#)

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## Abstract

Nature is bountiful of living biota which ranges from 3 to 50 million and one-third of global biodiversity exists in India. Since prehistoric times, humans have exploited microorganisms for their own use. The Earth's subsurface presents one of the finest promising locations to look for microbial life and the distinctive lithologies that life leaves behind. Studies on microbial diversity are hampered not only by the technical ability to assess the species numbers but also by the high heterogeneity of the environment, with its changing temporal and spatial microhabitats. Moreover, natural products are for the most part a booming source of drug leads. Regardless, their application in innovation of new drug has fallen out of favour. Not more than 10% of the planet's biodiversity has been under trial for biological property; a lot of functional natural compounds are pending innovation. The test is how to get in touch with this natural chemical diversity. In this aspect, research on caves is the utmost need of the hour to increase our acceptance of the means of biological adjustment to severe circumstances, the relations involving organisms and minerals, the function of inorganic matter in diverse dark ecosystems and the evolution and speciation of biological schemes under acute circumstances, progressing to a range of biotechnological uses. In the present chapter, a handful of the important caves

# Metallotolerant Bacteria: Insights into Bacteria Thriving in Metal-Contaminated Areas

Chapter | First Online: 10 April 2020

pp 135–164 | [Cite this chapter](#)

[Dina Barman](#), [Dhruva K. Jha](#) & [Kaushik Bhattacharjee](#)

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## Abstract

The overall condition of the environment is inevitably linked to nature of life on the Earth. However, due to industrial revolution, the global upsurge of accumulation of toxic metals has increased enormously which is posing a serious problem to human health. In such environment, where survival of indigenous microorganisms is difficult, metallotolerant bacteria are able to thrive by tolerating high levels of heavy metals. To cope with this extreme condition, they employ diverse mechanisms to overcome the toxic effects of metals and metalloids with alteration of different genes and proteins, and these mechanisms also help their possible commercial exploitation. Hence, it is essential to understand their unique metabolic capacity or physical structure which encourages thriving in these metal-rich environments. This chapter also sheds light on evolutionary strategies that facilitate the metallotolerant bacteria to adapt to the environment and associated ecophysiological aspects.



Fungal Biology

Ram Prasad *Editor*

# Mycoremediation and Environmental Sustainability

Volume 2

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# Application of Myconanotechnology in the Sustainable Management of Crop Production System

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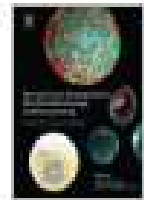
[Deepanwita Deka](#), [Jintu Rabiha](#) & [Dhruva Kumar Jha](#)

 Part of the book series: [Fungal Biology](#) ((FUNG BIO))

 1296 Accesses  2 Citations

## Abstract

Nanoscience deals with the manipulation of materials at atomic, molecular and macromolecular scales, where properties differ significantly from those at a larger scale. Nanotechnology has since long been successfully used in fields like medicine, environmental science, agriculture, etc. Though nanotechnology has been applied in production, processing, storing, packaging and transport of agricultural products, its application in crop protection and production is a less-researched area. Nanoparticles are synthesized using chemical and physical methods; this, however, involves the use of toxic chemicals besides high-energy requirement for their production. Scientists, therefore, are trying to synthesize metallic nanoparticles using living organisms such as bacteria, fungi and plants to avoid toxicity. The production of nanoparticles through biological methods is cheap, reliable, safe, easy to handle and nontoxic. A diverse range of fungi have been used for the production of nanoparticles using different metals. In recent years, nanofungicides, nanopesticides and nanoherbicides are extensively being used in agriculture. Nanoparticle-mediated gene transfer would be useful for generating resistance in crops against pathogens and pests. This chapter gives an overview of production of myconanoparticles using different fungal species and its potential applications in



## Chapter 12 - Metabolic Diversity of *Penicillium*

Jintu Rabha, Dhruva K. Jha

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### Abstract

Diversity in metabolic processes is fundamental to the fungal lifestyle, and members of the genus Penicillium are among the most important groups of fungi studied extensively for their varied and adaptable metabolism. Penicillium spp. have evolved a remarkable range of metabolic pathways, encoded by multiple gene clusters, which enable them to assimilate most organic matter as a source of nutrients. Several species are remarkable microbial cell factories capable of synthesizing an array of potent biomolecules during their growth and development. These molecules range from simple amino acids to peptides, pigments besides antibiotics and mycotoxins. Penicillium spp. also yield a wide range of bioactive metabolites having antibacterial, antifungal, immune suppressants, cholesterol-lowering and toxic properties, which can be applied in various sectors such as human health, industry and biotechnology. Immense potential of the filamentous fungi in the field of biology, medicine, and biotechnology is yet to be optimally exploited. In this chapter we have discussed in detail the carbon and nitrogen metabolism of