

BOMBAX CEIBA

The Silk Cotton Tree: New Paradigms in Green Innovation

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BOMBAX CEIBA — THE SILK COTTON TREE: NEW PARADIGMS IN GREEN INNOVATION

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Fraiz Parveen is a passionate researcher and academician at Uttarakhand University, actively engaged in advancing research and innovation. She has contributed to several peer-reviewed research papers and co-authored chapters in academic books, demonstrating her dedication to scientific communication and knowledge dissemination. Her work reflects a strong foundation in experimental design, data interpretation, and interdisciplinary collaboration.

Her work focuses on the synthesis of eco-friendly nanoparticles and their application in enhancing AI-based diagnostic tools, contributing to cutting-edge solutions in healthcare and environmental monitoring. Fraiz's interdisciplinary approach bridges natural sciences and emerging technologies, positioning her as a forward-thinking contributor to the field of AI-driven diagnostics and sustainable scientific advancement.

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Preface

Bombax ceiba – *The Silk Cotton Tree: New Paradigms in Green Innovation* explores the immense potential of this iconic tree at the intersection of traditional medicine, modern biotechnology, and sustainable development. Covering its morphology, taxonomy, ecology, phytochemistry, seed biology, and therapeutic uses, the book highlights cutting-edge genetic and biotechnological approaches alongside AI-driven research. With a focus on green innovation and the bioeconomy, it offers insights into conservation, future applications, and value-added utilization, making it an essential reference for researchers, students, and innovators in plant science, pharmacology, and sustainability.

Chapter 1: This chapter presents *Bombax ceiba* L., generally referred to as the red silk cotton tree or semal, giving an in-depth description of the taxonomy, systematic ranking, nomenclature, natural habitat and geographical distribution, its historical and cultural significance, ecological, medicinal and economic value, and contemporary scientific and future implications.

Chapter 2: A detailed study of the botanical aspects and growth physiology of *Bombax ceiba*, covering morphology, anatomy, reproductive features, seasonal phenology, germination, seedling establishment, biomass accumulation, and physiological adaptations that allow the species to live in various tropical and subtropical environments.

Chapter 3: This chapter presents the ecological and environmental importance of *Bombax ceiba* as a keystone tropical tree, demonstrating its structural benefits, carbon sequestration role, soil enrichment, biodiversity support, and contributions to climate adaptation, urban heat mitigation, and restoration ecology.

Chapter 4: An in-depth discussion of the phytochemical profile and nutritional profile of *Bombax ceiba*, covering bioactive substances and nutrients in its seeds, bark, flowers, gum, and roots, along with techniques of extraction, quantification, and characterization.

Chapter 5: This chapter presents the traditional, ethnomedicinal, and therapeutic potential of *Bombax ceiba*, exploring its use in Ayurveda, Unani, Siddha and folk medicine, with modern pharmacological validation of its anti-inflammatory, antioxidant, antimicrobial, antidiabetic, gastroprotective, and wound-healing properties.

Chapter 6: The authors discuss the versatile applicability of *Bombax ceiba* seeds as a source of proteins, oils, and bioactive compounds, covering seed morphology, physicochemical properties, functional food applications, biodegradable materials, and emerging seed-based technologies.

Chapter 7: This chapter discusses biotechnology and genetic research in enhanced crop development, including tissue culture, micropropagation, molecular markers, genomic tools, genetic transformation, genome editing, and metabolic engineering approaches.

Chapter 8: Examining the critical role of *Bombax ceiba* in sustainable development and the green economy, the chapter discusses agroforestry integration, reforestation, climate resilience, circular bioeconomy potential, and socioeconomic contributions to rural livelihoods.

Chapter 9: This chapter discusses the incorporation of artificial intelligence in *Bombax ceiba* research, covering AI-based growth prediction, disease detection, phytochemical profiling, image-based phenotyping, seed quality assessment, and conservation applications.

Chapter 10: The final chapter provides a comprehensive overview of future perspectives, challenges, and conservation strategies for *Bombax ceiba*, including ecological and genetic constraints, regulatory frameworks, emerging technologies, and integrative conservation approaches.

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Table of Contents

Authors Biography	iii
Preface	viii
Chapter 1 Morphological and Geographical Distribution: <i>Bombax ceiba</i>	1
Chapter 2 Taxonomical Characteristics Features and Reproductive Biology	9
Chapter 3 Ecological and Environmental Attributes	17
Chapter 4 Phytochemistry and Nutritional Profiling	24
Chapter 5 Traditional, Ethnomedicinal, and Therapeutic Potential	32
Chapter 6 Seed-Based Bioresources: Biology and Anatomy of <i>Bombax ceiba</i>	43
Chapter 7 Biotechnological Strategies and Genetic Characterization	52
Chapter 8 <i>Bombax ceiba</i> in Sustainable Development: Pathways to a Green Economy	60
Chapter 9 Integration of Artificial Intelligence in <i>Bombax ceiba</i> Research	69
Chapter 10 Future Perspectives, Challenges, and Conservation Strategies	78



Fraiz Parveen is a passionate researcher and academician at Uttaranchal University, actively engaged in advancing research and innovation. She has contributed to several peer-reviewed research papers and co-authored chapters in academic books, demonstrating her dedication to scientific communication and knowledge dissemination. Her work reflects a strong foundation in experimental design, data interpretation, and interdisciplinary collaboration. Her work focuses on the synthesis of eco-friendly nanoparticles and their application in enhancing AI-based diagnostic tools, contributing to cutting-edge solutions in healthcare and environmental monitoring. Fraiz's interdisciplinary approach bridges natural sciences and emerging technologies, positioning her as a forward-thinking contributor to the field of AI-driven diagnostics and sustainable scientific advancement.



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