

Molecular insights into self-incompatibility systems: From evolution to breeding

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ABSTRACT

Plants have evolved diverse self-incompatibility (SI) systems for outcrossing. Since Darwin's time, considerable progress has been made toward elucidating this unrivaled reproductive innovation. Recent advances in interdisciplinary studies and applications of biotechnology have given rise to major breakthroughs in understanding the molecular pathways that lead to SI, particularly the strikingly different SI mechanisms that operate in Solanaceae, Papaveraceae, Brassicaceae, and Primulaceae. These best-understood SI systems, together with discoveries in other "nonmodel" SI taxa such as Poaceae, suggest a complex evolutionary trajectory of SI, with multiple independent origins and frequent and irreversible losses. Extensive exploration of self-/nonself-discrimination signaling cascades has revealed a comprehensive catalog of male and female identity genes and modifier factors that control SI. These findings also enable the characterization, validation, and manipulation of SI-related factors for crop improvement, helping to address the challenges associated with development of inbred lines. Here, we review current knowledge about the evolution of SI systems, summarize key achievements in the molecular basis of pollen–pistil interactions, discuss potential prospects for breeding of SI crops, and raise several unresolved questions that require further investigation.

Key words: self-incompatibility, *S*-RNase, evolution, genome editing, crop improvement

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INTRODUCTION

Self-incompatibility (SI) is one of the most important reproductive innovations for prevention of self-fertilization. It enables a plant to recognize and reject self-pollen or pollen from genetically identical individuals, thereby promoting outcrossing (de Nettancourt, 2001). Particularly for many hermaphroditic species, SI represents the most widespread strategy for avoiding inbreeding depression and reduced genetic variability (Silva and Goring, 2001; Porcher and Lande, 2005). Approximately 40% of angiosperm lineages, representing at least 100 plant families, have developed SI systems (Jigic et al., 2004). The diverse forms of SI systems and their scattered phylogenetic distribution suggest that SI has evolved *de novo* many times over the course of angiosperm evolution (Allen and Hiscock, 2008). The higher diversification rate observed in species with functional SI systems than in those with self-compatibility (SC) suggests strong species-level selection favoring obligate outcrossing (Goldberg et al., 2010). SI systems also

frequently experience losses that are not subsequently regained (Barnett, 2013). Therefore, the ancestral conditions, the evolutionary dynamics of loss and gain, and the polymorphic nature of SI systems have been of long-standing interest.

In classic genetic studies, SI was classified into two homomorphic types, gametophytic self-incompatibility (GSI) and sporophytic self-incompatibility (SSI), as well as heteromorphic SI (HSI) characterized by heterostyly (de Nettancourt, 2001; Barnett and Shore, 2008). Since the advent of molecular biology, significant progress has been made in elucidating the genetic control of GSI in Solanaceae and Papaveraceae (Fuji et al., 2016), SSI in Brassicaceae (Goring et al., 2023), HSI in

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Molecular Insights Into The Living Proce

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Jian Zhang, 2026-01-12 Provides comprehensive up to date information on current topics in protein protein interaction drug discovery **The Science of Life** Kenneth Fisher, 2013-03-08 The Science of Life Contributions of Biology to Human Welfare is the first of what we anticipate will be a series of monographs resulting from activities of the Federation of American Societies for Experimental Biology From time to time material drawn from symposia presented at the annual meetings of the Societies when considered suitable will be published as separate FASEB Monographs Usually the material will have appeared in Federation Proceedings Occasionally other papers resulting from symposia conferences or special meetings sponsored by the Federation or one of its constituent societies will appear as a FASEB monograph In some instances special articles on the same topic will be drawn together under one cover Why should information which has already been printed and distributed as a part of the editorial content of a journal be republished as a monograph Most of the material to be included in this effort particularly the symposia presented at the annual meetings of the six Federated Societies will summarize the state of the art excellently Such information will be of considerable value to students and teachers especially for undergraduate honors courses or in graduate studies *The Publishers' Trade List Annual*, 1976

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chemistry and function of these microbial produced macromolecules We encouraged original research and reviews on exopolymeric substances from their sources chemico physiological properties functions and ecosystem effects and including their role in the Gulf of Mexico following the Deepwater Horizon oil spill disaster

Changing Views on Living Organisms Christian Neri,2013-04-03 Genome science or genomics is essential to advancing knowledge in the fields of biology and medicine Specifically researchers learn about the molecular biology behind genetic expression in living organisms and related methods of treating human genetic diseases including gene therapy Advances in Genome Science is an e book series which provides a multi disciplinary view of some of the latest developments in genome research allowing readers to capture the essentiality and diversity of genomics in contemporary science

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Herpetology Laurie J. Vitt,Janalee P. Caldwell,2013-03-25 The fourth edition of the textbook Herpetology covers the basic biology of amphibians and reptiles with updates in nearly every conceptual area Not only does it serve as a solid foundation for modern herpetology courses but it is also relevant to courses in ecology behavior evolution systematics and morphology Examples taken from amphibians and reptiles throughout the world make this book a useful herpetology textbook in several countries Naturalists amateur herpetologists herpetoculturists zoo professionals and many others will find this book readable and full of relevant

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Mammals of Africa Jonathan Kingdon, David Happold, Thomas Butynski, Michael Hoffmann, Meredith Happold, Jan Kalina, 2013-05-23 Mammals of Africa MoA is a series of six volumes which describes in detail every currently recognized species of African land mammal This is the first time that such extensive coverage has ever been attempted and the volumes incorporate the very latest information and detailed discussion of the morphology distribution biology and evolution including reference to fossil and molecular data of Africa's mammals With 1 160 species and 16 orders Africa has the greatest diversity and abundance of mammals in the world The reasons for this and the mechanisms behind their evolution are given special attention in the series Each volume follows the same format with detailed profiles of every species and higher taxa The series includes some 660 colour illustrations by Jonathan Kingdon and his many drawings highlight details of morphology and behaviour of the species concerned Diagrams schematic details and line drawings of skulls and jaws are by Jonathan Kingdon and Meredith Happold Every species also includes a detailed distribution map Extensive references alert readers to more detailed information Volume I Introductory Chapters and Afrotheria 352 pages Volume II Primates 560 pages Volume III Rodents Hares and Rabbits 784 pages Volume IV Hedgehogs Shrews and Bats 800 pages Volume V Carnivores Pangolins Equids and Rhinoceroses 560 pages Volume VI Pigs Hippopotamuses Chevrotains Giraffes Deer and Bovids 704 pages

Frontiers in Polar Biology in the Genomic Era National Research Council, Polar Research Board, Committee on Frontiers in Polar Biology, 2003-08-08 As we enter the twenty first century the polar biological sciences stand well poised to address numerous important issues many of which were unrecognized as little as 10 years ago From the effects of global warming on polar organisms to the potential for life in subglacial Lake Vostok the opportunities to advance our understanding of polar ecosystems are unprecedented The era of genome enabled biology is upon us and new technologies will allow us to examine polar biological questions of unprecedented scope and to do so with extraordinary depth and precision Frontiers in Polar Biology in the Genomic Revolution highlights research areas in polar biology that can benefit from genomic technologies and assesses the impediments to the conduct of polar genomic research It also emphasizes the importance of ancillary technologies to the successful application of genomic technologies to polar studies It recommends the development of a new initiative in polar genome sciences that emphasizes collaborative multidisciplinary research to facilitate genome analyses of polar organisms

and coordinate research efforts *Computational and Experimental Studies in Alzheimer's Disease* Kunal Bhattacharya, Atanu Bhattacharjee, 2024-03-29 This reference book compiles the recent advances in computational and experimental modelling to screen and manage Alzheimer's disease. It covers basic etiopathology and various in vitro and in vivo strategies of disease intervention. The book discusses how computer aided drug design approaches reduce costs and increase biological test efficiency. It reviews the screening for anti Alzheimer drugs and biomarker analysis of disease inhibitors. The book also explores mechanistic aspects of neurodegeneration and the use of natural products as therapeutics for Alzheimer's disease. Key features: Elaborates on the computational modelling of protein target inhibitors as anti Alzheimer's agents. Explains the role of phytochemicals and natural products in Alzheimer's therapy. Reviews preclinical ways to assess drugs focusing on Alzheimer's disease. Covers biomarker analysis for Alzheimer's disease. Discusses the onset and progression of Alzheimer's disease. The book is meant for professionals, researchers and students of neuroscience, psychology and computational neurosciences.

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Recent Advances in Food Biotechnology Ajay Kumar, Kiran Patruni, Vijai Singh, 2022-06-24 This book highlights

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Who Gives a Gigabyte? Gary Stix, Miriam Jacob, 1999-03-15 An exhilarating chronicle of the most revolutionary advancements in recent and future technology Which new technologies are bound to have the biggest impact on our lives in the years ahead This groundbreaking book looks at the latest technological superstars destined to reshape the upcoming century and offers easy to understand engaging explanations of what they are how they work and how they will affect our lives Written by a senior editor of Scientific American the world's premier science magazine and based on in depth interviews with today's leading innovators as well as extensive research of the latest scientific literature Who Gives a Gigabyte takes you on a fast paced tour into the brave new world of gene therapy quantum computation designer drugs and recyclable cars Surveying the wide range of technological wonders the authors investigate such diverse realms of scientific advancement as computing telecommunications laser beams bioengineering materials and alternative energy sources From the Human Genome Project which aims to spell out every letter of our genetic inheritance to the implications of altering genes in important agricultural projects to new strategies for attacking malignant cancer cells without the damaging side effects of traditional treatments to the startling but still unsuccessful attempts to make computer software more like the human mind Who Gives a Gigabyte demystifies the technology of today and provides an enlightening glimpse into the limitless possibilities of tomorrow An enjoyable and rewarding book Choice An informative overview of new and emerging technologies Booklist The reward for the reader is a solid grounding in technological literacy Scientific American

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Pollutants in Buildings, Water and Living Organisms Eric Lichtfouse, Jan Schwarzbauer, Didier Robert, 2015-08-31 This book presents advanced methods to analyse and clean pollutants such as nanotechnology to treat water techniques to remediate building materials and bioindicators It is very important that the understanding of these methods are brought to the attention of scientists as cities and ecosystems are still polluted by toxic compounds despite

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