

Advanced Concepts in Plant Genetics and Breeding Science

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VITAL BIOTECH PUBLICATION

Kota, Rajasthan, India

<http://www.vitalbiotech.org/bookpublication/>

An International Publishers

VITAL BIOTECH get Accredited by following International organization



<https://www.portico.org/publishers/vital/>

101 Greenwich Street, 18th Floor

New York, NY 10006

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Published by Vital Biotech Publication

First Edition: 2026

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Product Form:

Digital download, online and hard bound

Edition:

ISBN: 978-93-48793-65-2

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Printed at: Vital Biotech Publication, Kota

Preface

Plant genetics and breeding have played a central role in the development of agriculture and the improvement of crop productivity throughout human history. In the twenty-first century, rapid advances in molecular biology, genomics, bioinformatics, and biotechnology have transformed traditional breeding approaches into highly precise and efficient scientific disciplines. The integration of classical genetics with modern breeding technologies has opened new avenues for developing crop varieties with improved yield, quality, nutritional value, and resilience to biotic and abiotic stresses.

Advanced Concepts in Plant Genetics and Breeding Science is designed to provide a comprehensive understanding of the principles, methodologies, and emerging technologies that underpin contemporary crop improvement programs. The subject encompasses a wide range of topics, including Mendelian and quantitative genetics, molecular markers, genetic mapping, genomic selection, heterosis, hybrid breeding, mutation breeding, plant tissue culture, transgenic technologies, and genome editing tools such as CRISPR/Cas systems.

The growing challenges of global food security, climate change, shrinking agricultural resources, and evolving pest and disease pressures demand innovative and sustainable breeding strategies. Modern genetic and genomic tools enable breeders to identify, characterize, and manipulate genes associated with economically important traits with unprecedented accuracy and speed.

This book is intended for undergraduate and postgraduate students, researchers, plant breeders, and professionals in agricultural sciences. It is hoped that this text will serve as a valuable resource for enhancing knowledge, fostering innovation, and supporting future advances in plant genetics and breeding science.

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Dated – 25 Feb., 2026

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