

PREFACE

Plant tissue culture has now emerged as one of the major components of plant biotechnology. This field of experimental botany begins its journey with the concept of 'cellular totipotency' for demonstration of plant morphogenesis. Decades of research in plant tissue culture has passed through many challenges, created new dreams and resulted in landmark achievements. Considerable progress has been made with regard to the improvement of media formulations and techniques of cell, tissue, organ, and protoplast culture. Such advancement in cultural methodology led many recalcitrant plants amenable to *in vitro* regeneration and to the development of haploids, somatic hybrids and pathogen free plants. Tissue culture methods have also been employed to study the basic aspects of plant growth, metabolism, differentiation and morphogenesis and provide ideal opportunity to manipulate these processes.

Recent development of *in vitro* techniques has demonstrated its application in rapid clonal propagation, regeneration and multiplication of genetically manipulated superior clones, production of secondary metabolites and *ex-situ* conservation of valuable germplasms. This has been possible not only due to the refinements of cultural practices and applications of cutting-edge areas of molecular biology but also due to the judicious inclusion of engineering principles and methods to the system. In the present scenario, inclusion of engineering principles and methods has transformed the fundamental *in vitro* techniques into commercially viable technologies. Apart from the commercialization of plant tissue culture, engineering aspects have also made it possible to improve the regeneration of plants and techniques of cryopreservation. Strategies evolved utilize the disciplines of chemical, mechanical, electrical, cryogenics, and computer science and engineering.

In the years to come, the application of plant tissue culture for various biotechnological purposes will increasingly depend on the adoption of engineering principles and better understanding of their interacting factors with biological system. The present volume provides a cohesive presentation of the engineering principles and methods which have formed the keystones in practical applications of plant tissue culture, describes how application of engineering methods have led to major advances in commercial tissue culture as well as in understanding fundamentals of morphogenesis and cryopreservation, and focuses directions of future research, as we envisage them. We hope the volume will bridge the gap between conventional plant tissue culturists and engineers of various disciplines.

A diverse team of researchers, technologists and engineers describe in lucid manner how various engineering disciplines contribute to the improvement of plant tissue culture techniques and transform it to a technology. The volume includes twenty four chapters presenting the current status, state of the art, strength and weaknesses of the strategy applicable to the *in vitro* system covering the aspects of machine vision, bioreactor technology, mechanized micropropagation, engineering cultural environment and physical aspects of plant tissue engineering. The contributory chapters are written by international experts who are pioneers, and have made significant contributions to

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S. Dutta Gupta

Y. Ibaraki

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