
Preface

Plant tissue culture (PTC) broadly refers to cultivation of plant cells, tissues, organs, and plantlets on artificial medium under aseptic and controlled environmental conditions. PTC is as much an art as a science. It is the art of growing experimental plants, selecting a suitable plant organ or tissue to initiate cultures, cleaning, sterilization and trimming it to a suitable size, and planting it on a culture medium in right orientation while maintaining complete asepsis. It also requires an experienced and vigilant eye to select healthy and normal tissues for subculture. PTC involves a scientific approach to systematically optimize physical (nature of the substrate, pH, light, temperature and humidity), chemical (composition of the culture medium, particularly nutrients and growth regulators), biological (source, physiological status and size of the explant), and environmental (gaseous environment inside the culture vial) parameters to achieve the desired growth rate, cellular metabolism, and differentiation.

The most important contribution made through PTC is the demonstration of the unique capacity of plant cells to regenerate full plants, via organogenesis or embryogenesis, irrespective of their source (root, leaf, stem, floral parts, pollen, endosperm) and ploidy level (haploid, diploid, triploid). PTC is also the best technique to exploit the cellular totipotency of plant cells for numerous practical applications, and offers technologies for crop improvement (haploid and triploid production, in vitro fertilization, hybrid embryo rescue, variant selection), clonal propagation (Micropropagation), virus elimination (shoot tip culture), germplasm conservation, production of industrial phytochemicals, and regeneration of plants from genetically manipulated cells by recombinant DNA technology (genetic engineering) or cell fusion (somatic hybridization). PTC has been extensively employed for basic studies related to plant physiology (photosynthesis, nutrition of plant cells, and embryos), biochemistry, cellular metabolism, morphogenesis (organogenesis, embryogenesis), phytopathology (plant microbe interaction), histology (cytodifferentiation), cytology (cell cycle), etc. Indeed the discovery of first cytokinin is based on PTC studies.

Thus, PTC is an exciting area of basic and applied sciences with considerable scope for further research. Considerable work is being done to understand the physiology and genetics of embryogenesis and

organogenesis using PTC systems, especially *Arabidopsis* and carrot, which are likely to enhance the efficiency of in vitro regeneration protocols. Therefore, PTC forms a part of most of the courses on plant sciences (Developmental Botany, Embryology, Physiology, Genetics, Plant Breeding, Horticulture, Sylviculture, Phytopathology, etc.) and is an essential component of Plant Biotechnology.

After the first book on “*Plant Tissue Culture*” by Prof. P. R. White in 1943, several volumes describing different aspects of PTC have been published. Most of these are compilations of invited articles by different experts or proceedings of conferences. More recently, a number of books describing the methods and protocols for one or more techniques of PTC have been published which should serve as useful laboratory manuals. The impetus for writing this book was to make available an up-to-date text covering all theoretical and practical aspects of PTC for the students and early career researchers of plant sciences and agricultural biotechnology. The book includes 19 chapters profusely illustrated with half-tone pictures and self-explanatory diagrams. Most of the chapters include relevant media compositions and protocols that should be helpful in conducting laboratory exercises. For those who are interested in further details, Suggested Further Reading are given at the end of each chapter. We hope that the readers will find it useful. Suggestions for further improvement of the book are most welcome.

During the past two decades or so research in the area of plant biotechnology has become a closed door activity because many renowned scientists have moved from public research laboratories in universities and institutions to the private industry. Consequently, detailed information on many recent developments is not readily available.

We would like to thank many scientists who provided illustrations from their works and those who have helped us in completing this mammoth task. The help of Mr. Jai Bhargava and Mr. Atul Haseja in preparing some of the illustrations is gratefully acknowledged.

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