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Trees: Propagation and Conservation

Biotechnological Approaches for Propagation of a Multipurpose Tree, Balanites aegyptiaca Del.

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Preface

Micropropagation or plant tissue culture comprises a set of in vitro techniques, methods, and strategies that are part of the group of technologies called plant biotechnology. Plant tissue culture technology is playing an increasingly important role in basic and applied studies. Also, the application of tissue-culture technology, as a central tool or as an adjunct to other methods, including recombinant DNA techniques, is at the vanguard in plant modification and improvement for agriculture, horticulture and forestry.

Tree propagation in vitro has been a difficult proposition compared to other plants. The response of explants is primarily determined by genotype, physiological state of the tissue, and time of the year when the explants are collected and cultured. While most nurserymen have been introduced to the techniques and advantages of micropropagation, few have ventured to use it as a propagation tool. The applicability of micropropagation for woody trees has been demonstrated as feasible since all aspects of the technology have confirmed the fact that trees produced by this method look like and grow like their counterparts produced by traditional methods of cloning. The tree species in forest, plantation, and urban environments are important biological resources that play a major role in the economy and the ecology of terrestrial ecosystems, and they have aesthetic and spiritual value. Because of these many values of the tree species, preserving forest tree biodiversity through the use of biotechnological approaches should be an integral component in any forestry program in addition to large-scale ecologically sustainable forest management and preservation of the urban forest environment. Biotechnological tools are available for conserving tree species as well as genetic characterization that will be needed for deployment of germplasm through restoration activities. This book concentrates on the biotechnological tools available for multiplying, conserving, characterizing, evaluating, and enhancing the forest tree biodiversity, especially a multipurpose semi-arid tree *Balanites aegyptiaca* Del.

Micropropagation has gained the status of a multibillion dollar-industry being practiced in hundreds of biotechnology laboratories and nurseries throughout the world. As compared to annual herbaceous plants, tissue culture of trees is a difficult proposition mainly because of their being intractable to regenerate and slow growing and having the problems of dormancy, juvenility versus maturity, phenolics, and endogenous infection as well as great physiological variation in explants collected from fields besides less consistent efforts made at the global level. In vitro micropropagation has proved, in

the recent past, a means for supply of planting material for forestry. Different basal media, plant growth regulators, media additives, and carbohydrate sources are being used to manipulate culture conditions in vitro for propagation of forest trees. Micropropagation of forest trees in vitro is not only a means for mass scale propagation of superior clones of tree species but it can also be used for developing transgenic plants and conservation of germplasm through cryopreservation.

We anticipate that the conclusion of this book will be an increased awareness of the fact that there is still a great need for strategic research in applied sciences like plant biotechnology. The contents of the book also provide an indication of some of the information in which plant biotechnology (in vitro culture of trees) is likely to go in the coming years. At the very least, we feel that it should provide a source of background information and references to both students and researchers alike who wish to initiate or broaden their interests in the field.

It is noticeable that many of the chapters described in this book tend to be complimentary to each other, particularly where a combination of techniques may be required to achieve an ideal objective. This reinforce a vision held by us that plant biotechnology can rightly be considered a novel and key area of research involving both the applied and basic aspects of plant sciences.

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Ankita Varshney obtained her Ph.D. degree in Botany (Plant Biotechnology) in 2012 from the Aligarh Muslim University, Aligarh. Currently, she is working as a Young Scientist under DST-FAST TRACK scheme. Earlier, she worked as Research Associate of CSIR, New Delhi. She has published 10 research papers in journals of national and international repute. Her research focuses on in vitro regeneration, biochemical and molecular characterization of medicinal plants.

Mohammad Anis is a Professor and a Former Chairman in the Department of Botany at the Aligarh Muslim University, Aligarh. He has 26 years of teaching and research experience in cytogenetics, plant tissue culture and morphogenesis. He has published more than 150 research papers in journals of national and international repute. His current research focuses on morphogenesis and in vitro propagation of medicinal and woody plant species. He has been a Programme Coordinator of DST-FIST, DBT-HRD and UGC-DRS-I projects in the department. He has been conferred with "Vigyan Ratan Samman-2010" by the U.P. Council of Science and Technology.

Abbreviations

2-iP	2-isopentenyladenine
APX	Ascorbate peroxidase
B_5	Gamborg's medium
%	Percent
°C	Degree celsius
2,4-D	2,4-Dichlorophenoxyacetic acid
BA	6-Benzyladenine
BSA	Bovine serum albumin
CAT	Catalase
Chl	Chlorophyll
cm	Centimeter
CN	Cotyledonary node
CTAB	Cetyl-trimethylammonium bromide
d	Days
dATP	Dinucleotide adenine triphosphate
dCTP	Dinucleotide cytosine triphosphate
DDW	Double distilled water
dGTP	Dinucleotide guanine triphosphate
DNA	Deoxyribonucleic acid
dNTPs	Dinucleotide triphosphates
dTTP	Dinucleotide thiamine triphosphate
ε	Extinction coefficient
EDTA	Ethylene diamine tetraacetic acid
EU	Enzyme units
FAA	Formalin acetic acid
FW	Fresh weight
g	Gram
GR	Glutathione reductase
GSH	Reduced glutathione
GSSG	Oxidized glutathione
h	Hour
H_2O_2	Hydrogen peroxide
HCl	Hydrochloric acid
IAA	Indole-3-acetic acid
IBA	Indole-3-butyric acid
ISSR	Inter-sequence simple repeats
Kn	Kinetin (6-furfurylaminopurine)

L_2	Phillips and Collin's medium
M	Molarity
Mg	Miligram
mg/l	Miligram per liter
$MgCl_2$	Magnesium chloride
min	Minute
ml	Milliliter
mm	Millimeter
mM	Milimolar
MS	Murashige and Skoog medium
N	Normality
NAA	α-naphthalene acetic acid
NaCl	Sodium chloride
NADPH	Nicotinamide adenine dinucleotide phosphate
NaOH	Sodium hydroxide
NBT	Nitroblue tetrazolium
nm	Nanometer
OD	Optical density
PCR	Polymerase chain reaction
PGRs	Plant growth regulators
PPFD	Photosynthetic photon flux density
ppm	Parts per million
PVP	Polyvinyl pyrrolidone
RAPD	Random amplified polymorphism DNA
RH	Relative humidity
RNA	Ribonucleic acid
ROS	Reactive oxygen species
rpm	Rotation per minute
sec	Second
SOD	Superoxide dismutase
TBE	Tris-borate EDTA
TCA	Trichloroacetic acid
TDZ	Thidiazuron
TE	Tris-HCl EDTA
U	Unit
UBC	University of British Columbia
UV	Ultraviolet
V	Volt
v/v	Volume by volume
W	Watt
w/v	Weight by volume
µg	Microgram
µM	Micromolar