

Contents

Preface

ix

Section A

1. **Slash pine (*Pinus elliottii* Engelm.)** 1
R.J. Newton, W. Tang, S.M. Jain
2. **Somatic embryogenesis and genetic transformation in *Pinus radiata*** 11
C. Walters, J.I. Find, L. J. Grace
3. **Douglas –fir (*Pseudotsuga menziesii*)** 25
P.K. Gupta, D. Holmstrom
4. **Omorika spruce (*Picea omorika*)** 35
S. Mihaljevic, S. Jelaska
5. **Somatic embryogenesis in *Picea glauca*** 47
E.C. Yeung, T.A. Thorpe
6. **Protocol of somatic embryogenesis: Black spruce (*Picea mariana* (Mills.) B.S.P.)** 59
F.M. Tremblay, D Iraqi, A. El Meskaoui
7. **Sitka spruce (*Picea sitchensis*).** 69
D. Thompson, F. Harrington
8. **Protocol of somatic embryogenesis of *Pinus nigra* Arn.** 81
T. Salajova, R. Rodriguez, M.J. Canal, L.B. Diego, M. Berdasco, L. Radojevic, J. Salaj
9. **Loblolly pine (*Pinus taeda*)** 95
W. Tang, R.J. Newton
10. **Somatic embryogenesis in maritime pine (*Pinus pinaster* Ait.)** 107
L. Harvengt

11. **Somatic embryogenesis in *Pinus patula*** 121
C.S. Ford, L.J. Fischer, N.B. Jones, S.A. Nigro, N.P. Makunga, J. van Staden
12. **Somatic embryogenesis in Norway spruce** 141
M. Vagner, L. Fischerova, J. Spackova, Z. Vondrakova

Section B

13. **Cashew (*Anacardium occidentale* L.)** 157
R.S. Nadgauda, S. S. Gogate
14. **Somatic embryogenesis protocol: coffee (*Coffea arabica* L. and *C. canephora* P.)** 167
H. Etienne
15. **Protocols for somatic embryogenesis and plantlet formation from three explants in tea (*Camellia sinensis* (L.) o. kuntze)** 181
A. Akula, C. Akula
16. **Protocol of somatic embryogenesis from *Citrus* spp. anther culture** 191
M.A. Germana
17. **Integration system for propagation of *Theobroma cacao* L.** 209
S.N. Maximova, A. Young, S. Pishak, C. Miller, A. Traore, M.J. Guiltinan
18. **Mango (*Mangifera indica* L.)** 229
H. Ara, U. Jaiswal, V.S. Jaiswal
19. **Somatic embryogenesis in jackfruit (*Artocarpus heterophyllus* Lam.)** 247
S.K. Roy, R.K. Debnath
20. **Somatic embryogenesis in Indian olive (*Elaeocarpus robustus* L.)** 257
S.K. Roy, P. Sinha
21. **Rescue of endangered palms by *in vitro* methods: the case of 'bottle palm'** 267
V. Sarasan, M.M.Ramsay, A.V. Roberts
22. **Somatic embryogenesis in American grapes (*Vitis x labruscana* L.H.Bailey)** 275
S. Motoike, R.M. Skirvin, M.A. Norton, R.M. Mulwa

23.	Pistachio, <i>Pistachio vera</i> L. <i>A. Onay</i>	289
24.	Grape (<i>Vitis vinifera</i> L.) <i>D.K. Das, M.K. Reddy, K.C. Upadhyaya, S.K. Sopory</i>	301
25.	Date palm, <i>Phoenix dactylifera</i> L. <i>J.M. Al-Khayri</i>	309
26.	Somatic embryogenesis protocol: <i>Citrus</i> <i>F. Carimi</i>	321
27.	Olive (<i>Olea europaea</i> L.) <i>E. Rugini, M. Mencuccini, R. Biasi, M.M. Altamura</i>	345

Section C

28.	Protocol of somatic embryogenesis: <i>Dalbergia sissoo</i> Roxb. (Sissoo) <i>A.K. Singh, S. Chand</i>	361
29.	Protocol of somatic embryogenesis: Pedunculate oak (<i>Quercus robur</i> L.) and sessile oak (<i>Quercus petraea</i> /Matt./Liebl.) <i>V. Chalupa</i>	369
30.	Protocol of somatic embryogenesis: tamarillo (<i>Cyphomandra betacea</i> (Cav.) Sendtn.) <i>J.M. Canhoto, M.L. Lopes, G.S. Cruz</i>	379
31.	Protocol of somatic embryogenesis: European chestnut (<i>Castanea sativa</i> Mill.) <i>U. Sauer, E Wilhelm</i>	391
32.	Protocol of somatic embryogenesis in <i>Acacia arabica</i> (Lamk.) Willd. <i>G.R. Rout, R.M. Nanda</i>	401
33.	Protocol for hazelnut somatic embryogenesis <i>B. Berros, R. Hasbun, L. Radojevic, T. Salajova, M.J. Canal, R. Rodriguez</i>	413
34.	Protocol of somatic embryogenesis: <i>Ocotea catharinensis</i> Mez. (Lauraceae) <i>A.M. Viana, C. Santa-Catarina, E. Floh, Z. Bouzon, J.R. Moser</i>	427

35.	Cork oak, <i>Quercus suber</i> L. <i>M. Toribio, C. Celestino, M. Molinas</i>	445
36.	Sawara cypress, <i>Chamaecyparis pisifera</i> Sieb. et Zucc. <i>T.E. Maruyama, Y Hosoi, K. Ishii</i>	459
37.	Protocol of somatic embryogenesis: Holm oak (<i>Quercus ilex</i> L.) <i>P.V. Mauri, J.A. Manzanera</i>	469
38.	Protocol of somatic embryogenesis of hybrid firs <i>T. Salaj, B. Vookova, J. Salaj</i>	483
39.	Somatic embryogenesis in sandalwood <i>V. R. Ravishankar</i>	497
40.	<i>Echinacea purpurea</i> L: Somatic embryogenesis from leaf explant: <i>S. M.A. Zobayed, P.K. Saxena</i>	505

Section D

41.	Histological techniques <i>E.C. Yeung, P.K. Saxena</i>	517
42.	Bioencapsulation of somatic embryos in woody plants <i>V.A. Bapat, M. Mhatre</i>	539
43.	Protoplast isolation and culture of woody plants <i>J. Liu</i>	553
44.	Cryopreservation of embryonal cells <i>P.K. Gupta, R. Timis, D. Holmstrom</i>	567
45.	Double staining technology for distinguishing embryogenic cultures <i>P.K. Gupta, D. Holmstrom</i>	573
46.	Thin cell layer sectioning for inducing somatic embryogenesis in woody plants <i>Duong Tan Nihut, J.A. Teixeira de Silva, Bui Van Le</i>	577