

## THE EFFECT OF TEMPERATURE ON CONVERSION OF WHITE SPRUCE SOMATIC EMBRYOS

Sharon E. Pond

Canadian Forest Service- Maritimes Region, P.O. Box 4000, Fredericton, New Brunswick, Canada E3B 5P7,  
Fax: + 1 (506) 452 3525, E-mail: spond@nrcan.gc.ca

### REFERENCES

- Attree S. M., Pomeroy M. K., Fowke L. C. (1995). Development of white spruce (*Picea glauca* (Moench.) Voss) somatic embryos during culture with abscisic acid and osmoticum, their tolerance to drying and frozen storage. *Journal of Experimental Botany*, 46 (285): 433-439.
- Attree S. M., Fowke L. C. (1993). Embryogeny of gymnosperms: advances in synthetic seed technology of conifers. *Plant Cell, Tissue and Organ Culture*, 35: 1-35.
- Beardmore T., Charest P. J. (1995). Black spruce somatic embryo germination and desiccation tolerance. I. Effects of abscisic acid, cold, and heat treatments on the germinability of mature black spruce somatic embryos. *Canadian Journal of Forest Research*, 25: 1763-1772.
- Bewley J. D., Black M. (1994). *Seeds. Physiology of development and germination* (second edition). Plenum Press, 445 pp.
- Corredoira E., Ballester A., Vietez A. M. (2003). Proliferation, maturation and germination of *Castanea sativa* Mill. Somatic embryos originated from leaf explants. *Annals of Botany*, 92: 129-136.
- Downie B., Bewley J. D. (2000). Soluble sugar content of white spruce (*Picea glauca*) seeds during and after germination. *Physiologia Plantarum*, 110: 1-12.
- Dronne S., Label P., Lelu M.-A. (1997). Desiccation decreases abscisic acid content in hybrid larch (*Larix x leptoeuropaea*) somatic embryos. *Physiologia Plantarum*, 99: 433-438.
- Dunstan D. I., Dong J.-Z., Carrier D. J., Abrams S. R. (1998). Review: Events following ABA treatment of spruce somatic embryos. *In Vitro Cellular and Developmental Biology*, 34: 159-168.
- Garcia-Martin G., Gonzalez-Benito M. E., Manzanera J. A. (2001). *Quercus suber* L. somatic embryo germination and plant conversion: pretreatments and germination conditions. *In Vitro Cellular and Developmental Biology- Plant*, 37: 190-198.
- Garcarrubio A., Legaria J. P., Covarrubias A. A. (1997). Abscisic acid inhibits germination of mature *Arabidopsis* seeds by limiting the availability of energy and nutrients. *Planta*, 203 (2): 182-187.
- Gusta L. V., Wilen R. W., Fu P. (1996). Low-temperature stress tolerance: the role of abscisic acid, sugars, and heat-soluble proteins. *HortScience*, 31 (1): 39-46.
- Guy C. L. (2003). Freezing tolerance of plants: current understanding and selected emerging concepts. *Canadian Journal of Botany*, 81: 1216-1223.
- Hallgren J.-E., Oquist G. (1990). Adaptations to Low Temperatures. *In: Alsher R. G., Cumming J. R. (Eds.). Stress Responses in Plants: Adaptation and Acclimation Mechanisms*. Wiley-Liss, John Wiley & Sons, Inc.: 265-294.
- Hay E. I., Charest P. J. (1999). Somatic embryo germination and desiccation tolerance in conifers. *In: Jain S. M., Gupta P. K., Newton R. J. (Eds.). Somatic Embryogenesis in Woody Plants Vol 4*, Kluwer Academic Publishers: 61-96.
- Howarth C. J., Ougham H. J. (1993). Tansley Review No. 51: Gene expression under temperature stress. *New Phytologist*, 125: 1-26.
- Kermode A. R. (1995). Regulatory mechanisms in the transition from seed development to germination: Interactions between the embryo and the seed environment. *In: Kigel J., Galili G. (Eds.). Seed Development and Germination*. Marcel Dekker, Inc.: 272-332.
- Kermode A. R., Bewley J. D., Dasgupta J., Misra S. (1986). The transition from seed development to germination: a key role for desiccation? *HortScience*, 21 (5): 1113-1118.

- Kermode A. R., Dumbroff E. B., Bewley J. D. (1989). The role of maturation drying in the transition from seed development to germination. VII. Effects of partial and complete desiccation on abscisic acid levels and sensitivity in *Ricinus communis* L. seeds. *Journal of Experimental Botany*, 40 (211): 303-313.
- Klimaszewska K., Bernier-Cardou M., Cyr D. R., Sutton B. C. S. (2000). Influence of gelling agents on culture medium gel strength, water availability, tissue water potential, and maturation response in embryogenic cultures of *Pinus strobes* L. *In Vitro Cellular and Developmental Biology - Plant*, 36: 279-286.
- Klimaszewska K., Morecny F., Jones-Overton C., Cooke J. (2004). Accumulation pattern and identification of seed storage proteins in zygotic embryos of *Pinus strobes* and in somatic embryos from different maturation treatments. *Physiologia Plantarum*, 121: 682-690.
- Konradova H., Grigova M., Lipavska H. (2003). Cold-induced accumulation of raffinose family oligosaccharides in somatic embryos of Norway spruce (*Picea abies*). *In Vitro Cellular and Developmental Biology-Plant*, 39: 425-427.
- Kott L. S., Beversdorf W. D. (1990). Enhanced plant regeneration from microspore-derived embryos of *Brassica napus* by chilling, partial desiccation and age selection. *Plant Cell, Tissue and Organ Culture*, 23: 187-192.
- Lelu M.-A., Klimaszewska K., Pflaum G., Bastien C. (1995). Effect of maturation duration on desiccation in hybrid larch (*Larix x leptoeuropaea* Dengler) somatic embryos. *In Vitro Cellular and Developmental Biology-Plant*, 31: 15-20.
- Mauri P. V., Manzanera J. A. (2004). Effect of abscisic acid and stratification on somatic embryo maturation and germination of Holm Oak (*Quercus ilex* L.) *In Vitro Cellular and Developmental Biology-Plant*, 40: 495-498.
- Palta J. P. (1990). Stress interactions at the cellular and membrane levels. *HortScience*, 25 (11): 1377-1381.
- Park Y. S. (2002). Implementation of conifer somatic embryogenesis in clonal forestry: technical requirements and deployment considerations. *Annals of Forest Science*, 59: 651-656.
- Park Y. S., Pond S. E., Bonga J. M. (1993). Somatic embryogenesis in white spruce (*Picea glauca*): genetic control, culture treatment effects, and implications for tree breeding. *Theoretical and Applied Genetics*, 86 (4): 427-436.
- Park Y. S., Pond S. E., Bonga, J. M. (1994). Somatic embryogenesis in white spruce (*Picea glauca*): genetic control in somatic embryos exposed to storage, maturation treatments, germination, and cryopreservation. *Theoretical and Applied Genetics*, 89 (6): 742-750.
- Pond S. E., von Aderkas P., Bonga J. M. (2002). Improving tolerance of somatic embryos of *Picea glauca* to flash desiccation with a cold treatment (desiccation after cold acclimation) *In Vitro Cellular and Developmental Biology-Plant*, 38: 334-341.
- Profumo P., Gastaldo P., Bevilacqua L., Carli S. (1991). Plant regeneration from cotyledonary explants of *Aesculus hippocastanum* L. *Plant Science*, 76: 139-142.
- Stasolla C., Kong L., Yeung E. C., Thorpe T. A. (2002). Maturation of somatic embryos in conifers: morphogenesis, physiology, biochemistry, and molecular biology. *In Vitro Cellular and Developmental Biology-Plant*, 38: 93-105.
- Takeo K., Koshioka M., Pharis R. P., Rajasekaran K., Mullins M. G. (1983). Endogenous gibberellin-like substances in somatic embryos of grape (*Vitis vinifera* x *Vitis rupestris*) in relation to embryogenesis and the chilling requirement for subsequent development of mature embryos. *Plant Physiology*, 73 (3): 803-808.
- Williams P. M., Ross J. D., Bradbeer J. W. (1973). Studies in seed dormancy VII; the abscisic acid content of the seeds and fruits of *Corylus avellana* L. *Planta*, 110: 303-310.