

**SOMATIC EMBRYOGENESIS AND HISTOLOGICAL OBSERVATION
OF *XANTHOCERAS SORBIFOLIA* BUNGE.**

Na Zhang^{1,2}, Yunxiang Zhang¹, Jinping Guo^{3*}, and Shujun Chang¹

¹College of Forestry, Shanxi Agricultural University, 1 Mingxian South Road, 030801 Taigu, Shanxi, China

²Shanxi Academy of Forestry Sciences, 105 Xinjian South Road, 030012 Taiyuan, Shanxi, China.

³College of Graduate Studies, Shanxi Agricultural University, 1 Mingxian South Road, 030801 Taigu, Shanxi, China,

*Fax: + 86354 6288 227, *E-mail: jinpguo@126.com

REFERENCES

- AN C., LEE H., LEE J., CHEONG E. J., LI Y., YI J.-S. (2016). Analysis of genetic diversity and differentiation of artificial population of yellowhorn (*Xanthoceras sorbifolium*) in China using ISSR markers. *Journal of Forestry Research*, 27: 1099-1104.
- ARZATE-FERNÁNDEZ A. M., GONZÁLEZ-GONZÁLEZ H., VÁZQUEZ-GARCÍA L. M., NORMAN-MONDRAGÓN T. H., GONZÁLEZ-VILLARREAL C., BRUMBLEY S. M., PIÑA-ESCUTIA J. L. (2015). Somatic embryogenesis and plant regeneration of *Tigridia pavonia* (L.f.) DC., a Mexican native ornamental plant. *Propagation of Ornamental Plants*, 15: 101-106.
- AZAD M. A. K., YOKOTA S., BEGUM F., YOSHIZAWA N. (2009). Plant regeneration through somatic embryogenesis of a medicinal plant, *Phellodendron amurense* Rupr. *In Vitro Cellular & Developmental Biology-Plant*, 45: 441-449.
- CHEN J. (2019). Efficient somatic embryogenesis and plant regeneration through callus initiation from seedling-derived leaf materials of maize (*Zea mays* L.). *Agricultural Biotechnology*, 8: 25-28.
- DE CARVALHO SILVA R., LUIS Z. G., SCHERWINSKI-PEREIRA J. E. (2012). Differential responses to somatic embryogenesis of different genotypes of Brazilian oil palm (*Elaeis guineensis* Jacq.). *Plant Cell, Tissue and Organ Culture*, 111: 59-67.
- FU H., GUO Y., LI W., DOU D., KANG T., KOIKE K. (2010). A new angeloylated triterpenoid saponin from the husks of *Xanthoceras sorbifolia* Bunge. *Journal of Natural Medicines*, 64: 80-84.
- GAMBORG O. L., MILLER R. A., OJIMA K. (1968). Nutrient requirements of suspension cultures of soybean root cells. *Experimental Cell Research*, 50: 151-115.
- GAO S. M., MA K., DU X. H., LI F. L. (2002). Advances in research on *Xanthoceras sorbifolia*. *Chinese Bulletin of Botany*, 19: 296-301 (in Chinese).
- GOW W.-P., CHEN J.-T., CHANG W.-C. (2010). Enhancement of direct somatic embryogenesis and plantlet growth from leaf explants of *Phalaenopsis* by adjusting culture period and explant length. *Acta Physiologiae Plantarum*, 32: 621-627.
- GU Y. H., GAO S. M., GUO H. H., LI F. L. (2004). Somatic embryogenesis of *Xanthoceras sorbifolia*. *Plant Physiology Communications*, 40: 311-313 (in Chinese).
- KHER M. M., NATARAJ M. (2019). Direct somatic embryogenesis and shoot regeneration from leaves and internodes of *Pluchea lanceolata* (DC.) C. B. Clarke. *In Vitro Cellular & Developmental Biology-Plant*, 55: 720-724.
- KRISHNA KUMAR G., THOMAS T. D. (2012). High frequency somatic embryogenesis and synthetic seed production in *Clitoria ternatea* Linn. *Plant Cell, Tissue and Organ Culture*, 110: 141-151.
- LANDI L., MEZZETTI B. (2006). TDZ, auxin and genotype effects on leaf organogenesis in *Fragaria*. *Plant Cell Reports*, 25: 281-288.
- LI B. G. (2004). Woody oil forest. In: Yang J. M., Huang W. R. (Eds). *Economic Forest Culture*. China Forestry Publishing House, Beijing: 330-334 (in Chinese).
- LI J., WANG C., SHU Y., SUN H., LIU Q., WANG D. (2010). The Establishment of *Xanthoceras sorbifolia* Bunge Somatic Embryogenesis System. *Northern Horticulture*, 11: 140-143 (in Chinese).
- LUO J. P., JIA J. F., GU Y. H., LIU J. (1999). High frequency somatic embryogenesis and plant regeneration in callus cultures of *As-tragalus adsurgens* Pall. *Plant Science*, 143: 93-99.
- MENEZES-SA T. S. A., DE FÁTIMA ARRIGONI-BLANK M., DA COSTA A. S., BLANK A. F., FEITOSA-ALCANTARA R. B. (2018). Direct somatic embryogenesis in *Cattleya tigrina* A. Rich. *Propagation of Ornamental Plants*, 18: 19-25.
- MIRICI S., PARMAKSIZ I., OZCAN S., SANCAK C., URANBEY S., SARIHAN E. O., GUMUSCU A., GURBUZ B., ARSLAN N. (2005). Efficient *in vitro* bulblet regeneration from immature embryos of endangered *Sternbergia fischeriana*. *Plant Cell, Tissue and Organ Culture*, 80: 239-246.
- MURASHIGE T., SKOOG F. (1962). A revised medium for rapid growth and bioassays with tobacco tissue cultures. *Physiologia Plantarum*, 15: 473-497.
- NAWROT-CHORABIK K., PIETRZYKOWSKI M. (2019). Ecophysiological aspects of *in vitro* biotechnological studies using somatic embryogenesis of callus tissue toward protecting forest ecosystems. *Journal of Forestry Research*, 30: 1159-1166.
- NAWROT-CHORABIK K. (2016). Plantlet regeneration through somatic embryogenesis in Nordmann's fir (*Abies nordmanniana*). *Journal of Forestry Research*, 27: 1219-1228.
- PAUL S., DAM A., BHATTACHARYYA A., BANDYOPADHYAY T. K. (2011). An efficient regeneration system via direct and indirect somatic embryogenesis for the medicinal tree *Murraya koenigii*. *Plant Cell, Tissue and Organ Culture*, 105: 271-283.
- RUANE J., SONNINO A., AGOSTINI A. (2010). Bioenergy and the potential contribution of agricultural biotechnologies in developing countries. *Biomass & Bioenergy*, 34: 1427-1439.
- SAEED T., SHAHZAD A., SHARMA S. (2020). Studies on single and double layered biocompatible encapsulation of somatic embryos in

- Albizia lebbek* and genetic homogeneity appraisal among synseed derived lines through ISSR markers. *Plant Cell, Tissue and Organ Culture*, 140: 431-445.
- SANIKHANI M., FRELLO S., SEREK M. (2006). TDZ induces shoot regeneration in various *Kalanchoë blossfeldiana* Poelln. cultivars in the absence of auxin. *Plant Cell, Tissue and Organ Culture*, 85: 75-82.
- STASOLLA C., YEUNG E. C. (2003). Recent advances in conifer somatic embryogenesis: improving somatic embryo quality. *Plant Cell, Tissue and Organ Culture*, 74: 15-35.
- WANG F., XIONG X. R., LIU C. Z. (2009). Biofuels in China: opportunities and challenges. *In Vitro Cellular & Developmental Biology-Plant*, 45: 342-349.
- YANG L., LI Y., SHEN H. (2012). Somatic embryogenesis and plant regeneration from immature zygotic embryo cultures of mountain ash (*Sorbus pohnuashanensis*). *Plant Cell, Tissue and Organ Culture*, 109: 547-556.
- YANG Y. (2019). Current situation and prospect of breeding research of *Xanthoceras sorbifolium*. *Forestry and Ecological Sciences*, 34: 363-368 (in Chinese).
- ZHANG Q., CHEN J., HENNY R. J. (2005). Direct somatic embryogenesis and plant regeneration from leaf, petiole, and stem explants of *Golden Pothos*. *Plant Cell Reports*, 23: 587-595.
- ZHANG N., GUO J., ZHANG Y., HAN Y. (2012). Plant regeneration via direct organogenesis of *Xanthoceras sorbifolia* Bunge. *Propagation of Ornamental Plants*, 12: 63-71.
- ZHAO J., CUI J., LIU J., LIAO F., HENNY R. J., CHEN J. (2012). Direct somatic embryogenesis from leaf and petiole explants of *Spathiphyllum* 'Supreme' and analysis of regenerants using flow cytometry. *Plant Cell, Tissue and Organ Culture*, 110: 239-249.
- ZHU H., YU L., LIU J., WANG M., ZHANG T., QIU F. (2019). A new coumarin glucoside ester from seeds oil leaving of *Xanthoceras sorbifolia*. *Chinese Herbal Medicines*, 11: 113-115.
- ZOU S., YAO X., ZHONG C., LI D., WANG Z., HUANG H. (2019). Recurrent somatic embryogenesis and development of somatic embryos in *Akebia trifoliata* (Thunb.) Koidz (Lardizabalaceae). *Plant Cell, Tissue and Organ Culture*, 139: 493-504.