

**SOMATIC EMBRYOGENESIS AND PLANT REGENERATION OF
TIGRIDIA PAVONIA (L.F.) DC., A MEXICAN NATIVE ORNAMENTAL PLANT**

**Amaury Martín Arzate-Fernández¹, Hugo González-González¹, Luis Miguel Vázquez-García²,
Thomas Héctor Norman-Mondragón¹, Claudia González-Villarreal³,
Stevens Michael Brumbley³, and José Luis Piña-Escutia^{1*}**

¹Faculty of Agricultural Science, University Autonomous of State of Mexico,
Toluca-Ixtlahuaca Highway km 11.5, University Campus “El Cerrillo”, 50200 Toluca, State of Mexico, Mexico,
*Fax: + 52-722-296-55-18, *E-mail: jlpinae@uaemex.mx

²University Center Tenancingo, University Autonomous of State of Mexico,
Tenancingo - Villa Guerrero Highway k.m. 1.5, 52400, Tenancingo, State of Mexico, Mexico

³University of North Texas, Department of Biological Sciences, W Sycamore,
Life Sciences Complex, Denton TX 76203-5017, USA

REFERENCES

- ABDUL NASIM S., ABDUL M., KAPOOR R., SAMAR F., ASLAM J., MAHMOODU Z. (2010). Somatic embryogenesis in *Allium sativum* L. (cv. Yamuna Safed 3): improving embryo maturation and germination with PGRs and carbohydrates. *Anales de Biología*, 32: 1-9.
- BOZZOLA J. J., RUSSEL L. D. (1998). *Electron microscopy: principles and techniques for biologists*. Second Edition. Jones and Bartlett Publishers, USA, 542 pp.
- CARRILLO-OCAMPO A., ENGLEMAN C. E. M. (2002). Anatomía de la semilla de *Tigridia pavonia* (Iridaceae). *Boletín de la Sociedad Botánica de México*, 70: 67-77.
- DEMETER Z., SURANYI G., ATTILA M. V., SRAMKO G., BEYER D., KÓNYA Z., VASAS G., HAMVAS M. M., MÁTH C. (2010). Somatic embryogenesis and regeneration from shoot primordia of *Crocus heuffelianus*. *Plant Cell, Tissue and Organ Culture*, 100: 349-353.
- DEO P. C., TAYLOR M., HARDING R. M., TYAGI A. P., BECKER D. K. (2010). Initiation of embryogenic cell suspensions of taro (*Colocasia esculenta* var. *esculenta*) and plant regeneration. *Plant Cell, Tissue and Organ Culture*, 100: 283-291.
- DIPTI S. F., MUJIB A. (2014). Morphological anomalies in somatic embryo structure in *Catharanthus roseus*: improving embryo germination by amending plant growth regulators, activated charcoal and sucrose level. *British Biotechnology Journal*, 4: 10-20.
- EMEK Y., ERDAG B. (2007). Somatic embryogenesis from leaf explants *Gladiolus anatolicus* (Moiss.) Stapf. *Pakistan Journal of Biological Sciences*, 10: 1190-1194.
- ERDAG B., EMEK Y., ARKTAS L. Y. (2009). *In vitro* somatic embryogenesis from cormel-derived callus cultures of *Gladiolus anatolicus* (Boiss.) Stapf. *Propagation of Ornamental Plants*, 9: 176-180.
- FAZELI-NASAB B., OMIDI M., AMIRITOKALDANI M. (2012). Callus induction and plant regeneration of wheat mature embryos under abscisic acid treatment. *International Journal of Agriculture and Crop Sciences*, 4: 17-23.
- GEORGE E. F., HALL M. A., DE KLERK G.-J. (2008). *Plant propagation by tissue culture*. Springer. Netherlands, 501 pp.
- GHOLAMI A. A., ALAVI S. V., MAJD A., FALLAHIAN F. (2013). Plant regeneration through direct and indirect somatic embryogenesis from immature seeds of citrus. *European Journal of Experimental Biology*, 3: 307-310.
- GODISHALA V., MANGAMOORI L., NANNA R. (2011). Plant regeneration via somatic embryogenesis in cultivated tomato (*Solanum lycopersicum* L.). *Journal of Cell and Tissue Research*, 11: 2521-2528.
- GOMEZ K. A., GOMEZ A. A. (1984). *Statistical procedures for agricultural research*. Jon Wiley & Sons, Singapore, 680 pp.
- KAPARAKIS G., ALDERSON P. G. (2002). Influence of high concentrations of cytokinins on the production of somatic embryos by germinating seeds of tomato, aubergine and pepper. *Journal of Horticultural Sciences and Biotechnology*, 77: 186-190.
- KIKUCHI A., SANUKI N., HIGASHI K., KOSHIBA T., KAMADA H. (2006). Abscisic acid and stress treatment are essential for the acquisition of embryogenic competence by carrot somatic cells. *Planta*, 223: 637-645.
- KIM T. D., AHN C. H., BAE K. H., CHOI Y. E. (2009). The embryogenic competency and morphological changes during somatic embryogenesis in *Iris pseudacorus*. *Plant Biotechnology Reports*, 3: 251-257.
- KLIMASZEWSKA K., PARK Y. S., OVERTON C., MACEACHERON I., BONGA J. M. (2001). Optimized somatic embryogenesis in *Pinus strobus* L. *In Vitro Cellular & Developmental Biology-Plant*, 37: 392-399.
- KUMAR L., SINCY J., NARMATHA B. (2012). Micropropagation of *Tigridia pavonia* (L.f) DC., a potential floricultural plant from twin scale explants. *Asian Pacific Journal of Reproduction*, 1: 38-41.
- LEE S. T., HUANG W. L. (2013). Cytokinin, auxin, and abscisic acid affects sucrose metabolism conduce to de novo shoot organogenesis in rice (*Oryza sativa* L.) callus. *Botanical Studies*, 54: 1-11.
- LITVAY J. D., VERMA D. C., JOHNSON M. A. (1985). Influence of a loblolly pine (*Pinus taeda* L.) culture medium and its medium components on growth and somatic embryogenesis of the wild carrot (*Daucus carota* L.). *Plant Cell Reports*, 4: 325-328.
- MOHAMMAD ALI S. B. G., KOUROSH V., HASSAN B. S., SIAMAK K., CHARLES L. (2010). Enhancement of maturation and germination of somatic embryos in Persian walnut (*Juglans regia* l.) using osmolites, hormones and cold treatments. *African Journal of Food Science*, 4: 735-743.
- MURASHIGE T., SKOOG F. (1962). A revised medium for rapid growth and bioassays with tobacco tissue cultures. *Physiologia Plantarum*,

- NORDINE A., TLEMCANI C. R., EL MESKAOUI A. (2014). Regeneration of plants through somatic embryogenesis in *Thymus hyemalis* Lange, a potential medicinal and aromatic plant. *In Vitro Cellular & Developmental Biology-Plant*, 50: 19-25.
- PACHECO G., GAGLIARDI R. F., CARNEIRO L. A., CALLADO C. H., VALLS J. F. M., MANSUR E. (2007). The role of BAP in somatic embryogenesis induction from seed explants of *Arachis* species from Sections *Erectoides* and *Procumbentes*. *Plant Cell, Tissue and Organ Culture*, 88: 121-126.
- PIÑA-ESCUZIA J. L., VAZQUEZ-GARCIA L. M., ARZATE-FERNANDEZ A. M. (2010). *In vitro* regeneration and genetic fidelity of *Tigridia pavonia* (L.f.) DC. *Electronic Journal of Biotechnology*, 13: 1-7.
- RAI M. K., SHEKHAWAT N. S., HARISH, GUPTA A. K., PHULWARIA M., RAM K., JAISWAL U. (2011). The role of abscisic acid in plant tissue culture: a review of recent progress. *Plant Cell, Tissue and Organ Culture*, 106: 179-190.
- SAAS E. J. (1958). *Botanical microtechnique*. Iowa State University, United States, 248 pp.
- SEZGIN M., DUMANOĞLU H. (2014). Somatic embryogenesis and plant regeneration from immature cotyledons of European chestnut (*Castanea sativa* Mill.). *In Vitro Cellular & Developmental Biology-Plant*, 50: 58-68.
- SHAHSVARI E. (2011). Impact of tryptophan and glutamine on the tissue culture of upland rice. *Plant, Soil and Environment*, 57: 7-10.
- SHARIFI G., EBRAHIMZADEH H., GHAREYAZIE B., KARIMI M. (2010). Globular embryo-like structures and highly efficient thidiazuron-induced multiple shoot formation in saffron (*Crocus sativus* L.). *In Vitro Cellular & Developmental Biology-Plant*, 46: 274-280.
- VÁZQUEZ-GARCÍA L. M. (2011). *Tigridias ornamentales: uso y distribución*. Universidad Autónoma Chapingo, México, 106 pp.
- VÁZQUEZ-GARCÍA L. M., NORMAN M. T. H., CORONA R. M. C. (2001). *Oceloxóchitl Tigridia pavonia* (L.f) DC. Universidad Autónoma del Estado de México, México, 102 pp.
- WU H. C., DU TOIT E. S., REINHARDT C. F. (2007). A protocol for direct somatic embryogenesis of *Protea cynaroides* L. using zygotic embryos and cotyledon tissues. *Plant Cell, Tissue and Organ Culture*, 89: 217-224.