





# Somatic embryogenesis and *in vitro* plant regeneration of Manzano (AAB) and Pelipita (ABB) banana cultivars

ADRIÁN JOSÉ ENRÍQUEZ-VALENCIA<sup>1</sup> , MARTÍN MATA-ROSAS<sup>2</sup> ,  
CLAUDIA-ANAHÍ PÉREZ-TORRES<sup>1,3</sup> , ENRIQUE IBARRA-LACLETTE<sup>1</sup> 

<sup>1</sup>Red de Estudios Moleculares Avanzados (REMAv), Instituto de Ecología A.C. (INECOL),  
Xalapa, Veracruz, México

<sup>2</sup>Red de Manejo Biotecnológico de Recursos, Instituto de Ecología A.C. (INECOL), Xalapa,  
Veracruz, México

<sup>3</sup>Investigador por México-Secretaría de Ciencia, Humanidades, Tecnología e Innovación (SECIHTI),  
Instituto de Ecología A.C. (INECOL), Xalapa, Veracruz, México

## Electronic Supplementary Material (ESM)

The authors are fully responsible for both the content and the formal aspects of the electronic supplementary material. No editorial adjustments were made.

2 Table S1. Percentages of embryogenic callus (EC) formation, somatic embryo (SE) germination, and plant regeneration reported for different explant types of *Musa* species in the cited protocols

Cultivar	Type of explant	EC formation			SE germination (%)			Plant regeneration			Reference
		EC formation	SE germination (%)	Plant regeneration	EC formation	SE germination (%)	Plant regeneration				
<i>Musa acuminata</i> cv. Grand Naine (AAA)	immature male flowers	—	91.4	—	—	—	—	—	—	Domergue et al. (2000)	
<i>Musa acuminata</i> cv. Berangan (AAA)	immature male flowers	21	15	92	—	—	—	—	—	Husin et al. (2014)	
<i>Musa acuminata</i> cv. Pisang Mas (AA)	immature male flowers	11.1	69.3	—	—	—	—	—	—	Jalil et al. (2003)	
<i>Musa acuminata</i> cv. Dwarf Brazilian (AAB)	immature male flowers	66.3	96	—	—	—	—	—	—	Khalil and Elbanna (2004)	
<i>Musa acuminata</i> cv. Pisang Mas (AA)	immature male flowers	41	17.3	14.2	—	—	—	—	—	Wei et al. (2005)	
<i>Musa acuminata</i> cv. Dwarf Cavendish	curds	12.5	12.5	—	—	—	—	—	—	Pérez-Hernández and Rosell-García (2008)	
<i>Musa acuminata</i> × <i>Musa balbisiana</i> cv. Spambia (AAB)	plant shoots	98	85	90	—	—	—	—	—	Sholi et al. (2009)	
<i>Musa acuminata</i> cv. Grand Naine (AAA)	immature male flowers	10.1	35	99	—	—	—	—	—	Youssef et al. (2010)	
<i>Musa acuminata</i> cv. Lal Kela (AAA)	immature male flowers	83.3	50	—	—	—	—	—	—	Meenakshi et al. (2011)	
<i>Musa acuminata</i> cv. Calcutta 4 (AA)	meristematic domes	8	28	—	—	—	—	—	—	López Torres et al. (2012)	
<i>Musa acuminata</i> ssp. <i>malaccensis</i> (AA)	zygotic embryo	97	99	—	—	—	—	—	—	Escobedo-Gracia Medrano et al. (2014)	
<i>Musa acuminata</i> × <i>Musa balbisiana</i> cv. Rasthali (AAB)	immature male flowers	17	65	92.5	—	—	—	—	—	Nandhakumar et al. (2018)	
<i>Musa acuminata</i> × <i>Musa balbisiana</i> cv. Manzano (AAB)	immature male flowers	35	90	—	—	—	—	—	—	Enríquez-Valencia et al. (2019)	
<i>Musa acuminata</i> cv. Datil (AA)	immature male flowers	20	22	—	—	—	—	—	—	Ortiz Vargas et al. (2018)	
<i>Musa acuminata</i> cv. Grand Naine (AAA)	immature male flowers	16	66	92.15	—	—	—	—	—	Nandhakumar et al. (2018)	
<i>Musa acuminata</i> × <i>Musa balbisiana</i> cv. Somrani monthan (ABB)	scalps	97	70	—	—	—	—	—	—	Rustagi et al. (2019)	

— the value was not reported in the cited source

<https://doi.org/10.17221/35/2025-HORTSCI>

## REFERENCES

- Domergue F.G.R., Ferrière N., Côte F.X. (2000): Morphohistological study of the different constituents of a banana (*Musa* AAA, cv. Grand naine) embryogenic cell suspension. *Plant Cell Reports*, 19: 748–754.
- Enríquez-Valencia A.J., Vázquez-Flota F.A., Ku-Cauich J.R., Escobedo-GraciaMedrano R.M. (2019): Differentially expressed genes during the transition from early to late development phases in somatic embryo of banana (*Musa* spp. AAB group, Silk subgroup) cv. Manzano. *Plant Cell, Tissue and Organ Culture*, 136: 289–302.
- Escobedo-GraciaMedrano R.M., Maldonado-Borges J.I., Burgos-Tan M.J., Valadez-González N., Ku-Cauich J.R. (2014): Using flow cytometry and cytological analyses to assess the genetic stability of somatic embryo-derived plantlets from embryogenic *Musa acuminata* Colla (AA) ssp. *malaccensis* cell suspension cultures. *Plant Cell, Tissue and Organ Culture*, 116: 175–185.
- Husin N., Jalil M., Othman R.Y., Khalid N. (2014): Enhancement of regeneration efficiency in banana (*Musa acuminata* cv. Berangan) by using proline and glutamine. *Scientia Horticulturae*, 168: 33–37.
- Jalil M., Khalid N., Yasmin Othman R. (2003): Plant regeneration from embryogenic suspension cultures of *Musa acuminata* cv. Mas (AA). *Plant Cell, Tissue and Organ Culture*, 75: 209–214.
- Khalil S.M., Elbanna A. (2004): Highly efficient somatic embryogenesis and plant regeneration via suspension cultures of banana (*Musa* spp.). *Arab Journal of Biotechnology*, 7: 99–110.
- López Torres J., G. Kosky R., Montano Perez N., Reinaldo Alvarez D., Rayas Cabrera A., Cabrera Jova M., Santos Pino A., Medero Vega V., Basail Pérez M., Roux N. (2012): New explant for somatic embryogenesis induction and plant regeneration from diploid banana ('Calcutta 4', *Musa* AA). *Bioteconología Vegetal*, 12: 25–31. (in Spanish)
- Meenakshi S., Shinde B.N., Suprasanna P. (2011): Somatic embryogenesis from immature male flowers and molecular analysis of regenerated plants in banana "Lal Kela" (AAA). *Journal of Fruit and Ornamental Plant Research*, 18: 15–30.
- Nandhakumar N., Kumar K., Sudhakar D., Soorianathasundaram K. (2018): Plant regeneration, developmental pattern and genetic fidelity of somatic embryogenesis derived *Musa* spp. *Journal of Genetic Engineering and Biotechnology*, 16: 587–598.
- Ortiz Vargas J.L., Sandoval Fernández J., Aguilar Vega M.E. (2018): Regeneration of plants from embryogenic cell suspensions of cv. 'Datil' (*Musa* AA): Morphological evaluation of plants in the field. *Journal of Agricultural Science and Technology B*, 8: 29–41.
- Pérez-Hernández J.B., Rosell-García P. (2008): Inflorescence proliferation for somatic embryogenesis induction and suspension-derived plant regeneration from banana (*Musa* AAA, cv. 'Dwarf cavendish') male flowers. *Plant Cell Reports*, 27: 965–971.
- Rustagi A., Shekhar S., Kumar D., Lawrence K., Bhat V., Sarin N.B. (2019): High speed regeneration via somatic embryogenesis in elite Indian banana cv. Somrani monthan (ABB). *Vegetos*, 32: 39–47.
- Sholi N.J.Y., Chaurasia A., Agrawal A., Sarin N.B. (2009): ABA enhances plant regeneration of somatic embryos derived from cell suspension cultures of plantain cv. Spambia (*Musa* sp.). *Plant Cell, Tissue and Organ Culture*, 99: 133–140.
- Wei Y.-R., Huang X.-L., Li J., Huang X., Li Z., Li X.-J. (2005): Establishment of embryogenic cell suspension culture and plant regeneration of edible banana *Musa acuminata* cv. Mas (AA). *Sheng Wu Gong Cheng Xue Bao*, 21: 58–65. (in Chinese)
- Youssef M., James A., Mayo-Mosqueda A., Ku-Cauich J.R., Grijalva-Arango R., Escobedo-G.M.R.M. (2010): Influence of genotype and age of explant source on the capacity for somatic embryogenesis of two Cavendish banana cultivars (*Musa acuminata* Colla, AAA). *African Journal of Biotechnology*, 9: 2216–2223.