

GROWTH AND CARBON BALANCE OF *LILIIUM* BULBLETS CULTURED UNDER HETEROTROPHIC AND DARK CONDITIONS

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REFERENCES

- BUNCE J. A. (1990). Short- and long-term inhibition of respiratory carbon dioxide efflux by elevated carbon dioxide. *Annals of Botany*, 65: 637-642.
- CHANG W., LI S. Y., HU H., FAN Y. Y. (2008). Photosynthetic characteristics of three varieties of *Lilium* "Oriental Hybrids" in the central areas of Yunnan Province, China. *Frontier of Biology China*, 3: 453-458.
- CHOUREY P. S., NELSON O. E. (1976). The enzymatic deficiency conditioned by the shrunken-1 mutations in maize. *Biochemical Genetics*, 14: 1041-1055.
- CHOUREY P. S., CHEN Y. C., MILLER M. E. (1991). Early cell degeneration in developing endosperm is unique to the shrunken mutation in maize. *Maydica*, 36: 141-146.
- CHUNG C. H., CHUNG Y. M., YANG S. J., KO E. K., JEONG S. J., NAM J. S., KIM G. T., YI Y. B. (2006). Effects of storage temperature and sucrose on bulblet growth, starch and protein contents in vitro cultures of *Hyacinthus orientalis*. *Biologia Plantarum*, 50: 346-351.
- CRISTEA V., DALLA-VECCHIA F., LA-ROCCA N. (1999). Development and photosynthetic characteristics of a photoautotrophic *Chrysanthemum* culture. *Photosynthetica*, 37: 53-59.
- DANTU P. K., BHOJWANI S. S. (1987). *In vitro* propagation and corm formation in gladiolus. *Gartenbauwissenschaft*, 52: 90-93.
- DE-RIEK J., VAN-CLEEMPUT O., DEBERGH P. C. (1991). Carbon metabolism of micropropagated *Rosa multiflora* L. *In Vitro Cellular and Developmental Biology-Plant*, 27: 57-63.
- DE-RIEK J., PIQUERAS A., DEBERGH P. C. (1997). Sucrose uptake and metabolism in a double layer system for micropropagation of *Rosa multiflora*. *Plant Cell, Tissue and Organ Culture*, 47: 269-278.
- DESIJARDINS Y., HDIDER C., DE-RIEK J. (1995). Carbon nutrition *in vitro*. Regulation and manipulation of carbon assimilation in micropropagated systems. In: Aitken-Christie J., Kozai T., Smith M. A. L. (Eds). *Automation and environmental control in plant tissue culture*. Kluwer Academic Publishers, Dordrecht, The Netherlands: 441-447.
- DONOVAN L., EHLERINGER J. (1994). Potential for selection on plants for water use efficiency as estimated by carbon isotope discrimination. *American Journal of Botany*, 81: 927-935.
- GALZY R., COMPAN D. (1992). Remarks on mixotrophic and autotrophic carbon nutrition of *Vitis* plantlets cultured *in vitro*. *Plant Cell, Tissue and Organ Culture*, 31: 239-244.
- GARNER N., BLAKE J. (1989). The induction and development of potato microtubers *in vitro* on media free of growth regulating substances. *Annals of Botany*, 63: 663-674.
- GOLLAGUNTA V., ADELBERG J. W., RIECK J., RAJAPAKSE N. (2004). Sucrose concentration in liquid media affects soluble carbohydrates, biomass and storage quality of micropropagated hosta. *Plant Cell, Tissue and Organ Culture*, 77: 125-131.
- HAZARIKA B. N. (2003). Acclimatization of tissue-cultured plants. *Current Science*, 85: 1704-1712.
- JOSHI S. K., DHAR U. (2009). *In vitro* propagation from axenic explants of *Lilium oxypetalum* (D. Don) Baker, an endemic bulbous plant of high altitude Himalaya. *Plant Physiology*, 31: 833-838.
- JO E. A., TEWARI R. K., HAHN E. J., PAK K. Y. (2009). *In vitro* sucrose concentration affects growth and acclimatization of *Alocasia amazonica* plantlets. *Plant Cell, Tissue and Organ Culture*, 96: 307-315.
- KOZAI T., FUJIWARA K., WATANABE I. (1986a). Effects of stoppers and vessels on gas exchange rates between inside and outside of vessels closed with stoppers. *Journal of Agricultural Meteorology*, 42: 119-127.
- KOZAI T., FUJIWARA K., WATANABE I. (1986b). Fundamental studies on environments in plant tissue culture vessels. *Journal of Agricultural Meteorology*, 42: 1-6.
- KUBOTA C., EZAWA M., KOZAI T., WILSON S. B. (2002). *In situ* estimation of carbon balance of *in vitro* sweet potato and tomato plantlets cultured with varying initial sucrose concentrations in the medium. *HortScience*, 127: 963-970.
- KUBOTA C., KAKIZAKI N., KOZAI T., KASAHARA K., NEMOTO J. (2001). Growth and net photosynthetic rate of tomato plantlets during photoautotrophic and photomixotrophic micropropagation. *HortScience*, 36: 49-52.
- LIAN M. L., CHAKRABARTY D., PAK K. Y. (2003). Growth of *Lilium* Oriental Hybrid 'Casablanca' bulblet using bioreactor culture. *Scientia Horticulturae*, 97: 41-48.
- MAILLARD L. C. (1913). Formation de matières humiques par action de polypeptides sur sucres. *Comptes Rendus de l'Académie des Sciences*, 156: 148-149.
- MARINENGELI P., CURVETTO N. (1997). Increased sucrose and salt concentration in culture medium improved growth of micropropagated *Lilium* bulblets. *Biocell*, 21: 161-164.

- MECOZZI M. (2005). Estimation of total carbohydrate amount in environmental samples by the phenol-sulphuric acid method assisted by multivariate calibration. *Chemometrics and Intelligent Laboratory Systems*, 79: 84-90.
- MILLS D. (2009). Effect of sucrose application, minerals, and irradiance on the *in vitro* growth of *Cistus incanus* seedlings and plantlets. *Biologia Plantarum*, 53: 415-421.
- MOORE B., ZHOU L., ROLLAND F., HALL Q., CHENG W. H., LIU Y. X., HWANG I., JONES T., SHEEN J. (2003). Role of the *Arabidopsis* glucose sensor HXK1 in nutrient, light, and hormonal signaling. *Science*, 300: 332-336.
- MURASHIGE T., SKOOG F. (1962). A revised medium for rapid growth and bioassays with tobacco tissue culture. *Physiologia Plantarum*, 15: 473-497.
- ODJAKOVA M. K., CONGER B. V. (1999). The influence of osmotic pretreatment and inoculum age on the initiation and regenerability of switchgrass suspension cultures. *In Vitro Cellular and Developmental Biology-Plant*, 35: 442-444.
- ROLLAND F., BAENA-GONZALEZ E., SHEEN J. (2006). Sugar sensing and signaling in plants: conserved and novel mechanisms. *Annual Review of Plant Biology*, 57: 675-709.
- SATOU T., MIMAKI Y., KURODA M., SASHIDA Y., HATAKEYAMA Y. (1996). A pyrroline glucoside ester and steroidal saponins from *Lilium martagon*. *Phytochemistry*, 41: 1225-1230.
- SERRET M. D., TRILLAS M. I., MATAS J., ARAUS J. L. (1997). The effect of different closure types, light, and sucrose concentrations on carbon isotope composition and growth of *Gardenia jasminoides* plantlets during micropropagation and subsequent acclimatization *ex vitro*. *Plant Cell, Tissue and Organ Culture*, 47: 217-230.
- SHIN K. S., CHAKRABARTY D., PAEK K. Y. (2002). Sprouting rate, change of carbohydrate contents and related enzymes during cold treatment of lily bulblets regenerated *in vitro*. *Scientia Horticulturae*, 96: 195-204.
- SMEEKENS G. S. M. (2000). Sugar induced signal transduction in plants. *Plant Physiology*, 51: 49-81.
- SUNG S. J. S., XU D. P., BLACK C. C. (1989). Identification of actively filling sucrose sinks. *Plant Physiology*, 89: 1117-1121.
- WOLF S., KALMAN-ROTEM N., YAKIR D., ZIV M. (1998). Autotrophic and heterotrophic carbon assimilation of *in vitro* grown potato (*Solanum tuberosum* L.) plants. *Plant Physiology*, 153: 574-580.
- YOKOI Y., KIMURA M., HOGETSU K. (1978). Quantitative relationships between growth and respiration. I. Components of respiratory loss and growth efficiencies of etiolated red bean seedlings. *Botanical Magazine, Tokyo*, 91: 31-41.