plants

MDPI

Article

Somatic Embryogenesis and Plantlet Regeneration in the *Carica papaya* L. cv. Eksotika

Baker Al-Shara [1,*], Rosna Mat Taha [1], Jamaludin Mohamad [1], Hashimah Elias [2] and Asif Khan [1]

[1] Institute of Biological Sciences, Faculty of Science, University Malaya, Kuala Lumpur 50603, Malaysia; rosna@um.edu.my (R.M.T.); jamal@um.edu.my (J.M.); asif.khan.qau@siswa.um.edu.my (A.K.)

[2] Faculty of Resource Science and Technology, University Malaysia Sarawak (UNIMAS), Kota Samarahan 94300, Sarawak, Malaysia; ehashimah@unimas.my

* Correspondence: b.alshara@siswa.um.edu.my or bakearbio@yahoo.com; Tel.: +96-27-9897-7085

Received: 11 February 2020; Accepted: 9 March 2020; Published: 12 March 2020

Abstract: A highly efficient protocol for regeneration of *Carica papaya* L. cv. Eksotika somatic embryos from immature zygotic embryos was developed. This study was designed to overcome the obstacles in regeneration of somatic embryos from immature zygotic embryos of "Eksotika", especially problems associated with formation of better root quality and callus formation at the base of somatic embryos. Somatic embryos were generated by incubation of immature zygotic embryos in half-strength salt Murashige and Skoog (MS) medium with full-strength vitamins supplemented with 7.5 mg L^{-1} 2,4-D, 100 mg L^{-1} L-glutamine, 50 mg L^{-1} *myo*-inositol, 45 mg L^{-1} adenine sulphate, 0.33% gelrite, and 6% sucrose, followed by transfer to maturation medium consisting of ½ MS medium supplemented with 5 mg L^{-1} phloroglucinol, 100 mg L^{-1} L-glutamine, 100 mg L^{-1} *myo*-inositol, 68 mg L^{-1} adenine sulphate, 0.38% gelrite, and 3% sucrose. After that, well-formed somatic embryos were transferred to MS medium containing 3% sucrose and 0.8% agar for shoot production. The embryos were elongated in MS medium supplemented with 1 mg L^{-1} gibberellic acid, 0.5 mg L^{-1} indole-3-butyric acid, 100 mg L^{-1} *myo*-inositol, and 3.76 mg L^{-1} riboflavin. Root regeneration was achieved on MS medium containing 7.9 mg L^{-1} phloroglucinol and supported with vermiculite after 4 days of cultivation on ½ MS medium with 2 mg L^{-1} indole-3-butyric acid. After the rooting phase, in vitro plantlets were acclimatized in peat moss soil.

Keywords: activated charcoal; indole-3-butyric acid; papaya; phloroglucinol; polyethylene glycol; somatic embryogenesis

1. Introduction

Carica papaya (Caricaceae, Papaya), especially the "Eksotika" cultivar, is a significant crop in Malaysia [1]. *C. papaya* is considered as an economically important fruit tree, especially for tropical and subtropical populations. The *C. papaya* fruit can either be consumed as a fresh fruit or used as a treated product. The unripe fruits contain latex, which is the source of papain, a plant proteolytic enzyme [2]. The papain enzyme is able to break down protein and polypeptide. Therefore, it plays a crucial role in drug purposes and pharmaceutical industry. It is also used for clearing beer, tenderizing meat, leather industry, cosmetics industry, and candy and chewing gum industry [3,4].

Improvement of *C. papaya* could be achieved by increasing yield and improving the qualitative characteristics of the fruit [5]. Mostly, the *C. papaya* plant is propagated by seeds, but this method of propagation forms dissimilarity between the seedlings and the mother plant and limits seed-based propagation of *C. papaya* in commercial quantities [6,7]. Therefore, clonal multiplication by utilizing somatic embryogenesis was adopted to overcome this problem [8]. Somatic embryogenesis is a process of generating embryogenic cells from somatic cells after exposure to induction conditions [9]. Somatic embryogenesis can be used to increase plant production through the propagation of elite