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STIMULATING EFFECT OF CEFOTAXIME AND SILVER NANOPARTICLES ON PLANT REGENERATION IN DATE PALM TISSUE CULTURE

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ABSTRACT

The essential challenges in practical applications of date palm micropropagation include explant browning, reduced callus growth, low multiplication rate, and frequent tissue contamination. Our study aimed to evaluate the effects of cefotaxime (Cefo) and silver nanoparticles (AgNPs) on microbial contamination removal, callus growth, and shoot regeneration in date palm micropropagation. Cultures were initiated from bud tips of 'Barhee' date palm. Murashige and Skoog medium with auxins, cytokinins, and activated charcoal was amended with Cefo (50, 100, and 200 $mg \cdot l^{-1}$), AgNPs (0.125 and 0.250 $mg \cdot l^{-1}$), and a combination of both. The medium supplemented with 200 $mg \cdot l^{-1}$ Cefo and 0.250 $mg \cdot l^{-1}$ AgNPs resulted in the best callus growth (318 mg). In contrast, 200 Cefo + 0.125 AgNPs resulted in maximum organogenesis and shoot number per jar (83.4% and 14.1 shoots per jar, respectively). These two combinations resulted in contaminant-free cultures. The total amount of phenolic compounds was significantly reduced to 0.79 and 0.57 mg $GAE \cdot g^{-1}$ DM in shoots cultured in the above media, which was reflected in the low browning rate. The data revealed that the maximum endogenous IAA content of shoots (2.681 $\mu g \cdot g^{-1}$ and 2.345 $\mu g \cdot g^{-1}$) was obtained in response to 200 $mg \cdot l^{-1}$ Cefo + 0.250 AgNPs and 200 $mg \cdot l^{-1}$ Cefo+ 0.125 $mg \cdot l^{-1}$ AgNPs, respectively. Therefore, the optimized compositions established in the present study could be applicable in reducing contamination and helping callus production and multiple shoot regeneration. To our knowledge, this is the first study of the antibacterial and growth-promoting effects of Cefo in combination with AgNPs in *in vitro* cultures of 'Barhee' date palm.

Key words: callus induction, contamination, micropropagation, plant regeneration, *Phoenix dactylifera*

INTRODUCTION

The date palm (*Phoenix dactylifera* L.) is one of the oldest fruit trees, the most widely consumed fruit in the world, and is considered an essential part of the diet in various cultures. The nutrients provided by date fruit are mainly glucose and fructose. Moreover, dates are a good source of necessary minerals such as potassium and magnesium (Al-Mssallem et al. 2020). Date palms are traditionally propagated by offshoots, which is inefficient because each tree produces several offshoots, especially in some genotypes, and fruiting can take up to seven years (Jasim et al. 2009; Gantait et al. 2018; Al-Mayahi 2022a, b). Therefore, rapid propagation of date palm by tissue culture is the most promising technique for producing large numbers of high quality date palm plantlets (Al-Asadi et al. 2020, 2024; Abdalla et al. 2022; Al-Mayahi 2022c). However, the use of plant tissue culture for commercial propagation of woody plants can be associated with several challenges, mainly fungal and bacterial contamination (Rout et al. 2006; Al-Mayahi et al. 2010). The adverse effects of microbial contamination are deterioration, browning, and death of infected tissue due to the release of toxic substances such as degrading enzymes (e.g., cellulase or phenoloxidase) into the medium (Emoghene et al. 2020; Ahmed & Abass 2022). Several methods prevent or eliminate contamination (Jasim et al. 2021; Permadi et al. 2023). Among other things, new antimicrobial compounds are being sought that will be effective in combating microorganisms and at the same time harmless to plant explants. Abdel-Karim (2017) reported that the incorporation of fungicides or antibiotics into the medium significantly reduced the contamination rate during different stages of *in vitro* date palm culture.

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