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RESEARCH ARTICLES

Indole acetic acid (IAA) producing endophytic bacteria on direct somatic embryogenesis and plant regeneration of *Exacum travancoricum* Bedd.

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Abstract

Endophytic bacteria were isolated from *Withania somnifera* (L.) Dunal and their potentials were explored through the in vitro plant regeneration techniques. Initially, indole acetic acid (IAA), phosphate solubilization and siderophore producing isolates were screened out. These isolates were identified using molecular tools like 16s rRNA gene sequences namely *Bacillus pumilus* AS02, *Sphingobacterium thalpophilum* AS34, *Pseudomonas aeruginosa* AS36, *Agrobacterium tumefaciens* AS38 and *Enterobacter aerogenes* AS75. Further, the regeneration efficacy of IAA producing endophytic bacteria has been analysed on an endangered plant—*Exacum travancoricum* Bedd. The leaf and inter-node explants of *E. travancoricum* with or without bacterial infection were tested on Murashige and Skoog's (MS) medium encompassing 6-benzyladenine (BA; 2.0 mg L^{-1}) and L-tryptophan (0.2%; w/v). Somatic embryo induction was observed on both explants. The leaf explants infected with *S. thalpophilum* AS34, *P. aeruginosa* AS36 and *E. aerogenes* AS75 exhibited highest percentage of somatic embryo induction (93.3%) compared with the inter-node explants (86.6%). The explants without bacterial infection (control) and the presence of exogenous IAA exhibited lower level of response (88.8%, leaf and 75.5%, inter-node). Histological analysis revealed the appearance of globular embryogenic masses on epidermal, sub-epidermal regions of both explants. The development of torpedo, cotyledon stage and protoderm formation without the vascular connection from explants confirmed direct somatic embryogenesis. This was confirmed with scanning electron microscopy. Sub-culturing of cotyledon somatic embryos in MS liquid medium without growth regulators was performed to obtain well developed shoots with roots.

Keywords Indole acetic acid · Endophytic bacteria · 16s rRNA gene sequence · Protoderm · Somatic embryos · *Withania somnifera* · *Exacum travancoricum*

Introduction

Recent advances in plant propagation include induction of beneficial microorganisms (Parray et al. 2015). Bacteria are found to be much helpful for plant growth and development due to the presence of plant growth regulators (PGR). A

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