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Entitled

THE USE OF ACTINOBACTERIA TO IMPROVE THE EFFICACY OF PHYTOREMEDIATION OF HEAVY METAL-POLLUTED SOILS IN THE UNITED ARAB EMIRATES

by

Fatima Abdulmoneim Bastawi Omer

Faculty Advisor

Prof. Khaled A. El-Tarabily, Department of Biology

College of Science

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Abstract

In an effort to gain the advantages provided by actinobacterial enzyme (1-aminocyclopropane-1-carboxylic acid) (ACC) deaminase (ACCD) in the phytoremediation of heavy metals from the environment, the ability of native actinobacteria with ACC deaminase activity to promote the growth of Bermuda grass (*Cynodon dactylon* L.) in soils contaminated with nickel nitrate was evaluated under greenhouse conditions. This enzyme will hydrolyze (ACC), the immediate biosynthetic precursors of the hormone ethylene (ET) in plant tissues to ammonia and α keto-butyrate. The main objectives of this study were: (1) To isolate beneficial native heavy metal-tolerant actinobacteria from the United Arab Emirates (UAE) contaminated soil capable of producing ACC deaminase; (2) to evaluate their potential to tolerate different concentrations of nickel nitrate; (3) to evaluate their potential to promote the growth of Bermuda grass plants in the presence of nickel nitrate under greenhouse conditions. To achieve this, 65 different actinobacterial isolates obtained from a Bermuda grass rhizosphere soil in the UAE were selected for their ability to tolerate different concentrations of nickel nitrate as well as to produce ACC deaminase. Out of these isolates, only 15 were able to tolerate different concentrations of nickel nitrate. Out of these 15 nickel nitrate-resistant actinobacteria, only 10 produced ACC deaminase. Under greenhouse conditions, the application of the strongest three rhizosphere competent actinobacterial isolates increased Bermuda grass growth in nickel nitrate-contaminated soils. The application of a mixture of three actinobacteria in the nickel-contaminated soils significantly ($P<0.05$) enhanced the growth of Bermuda grass compared to the control treatments. Soil inoculation with the mixture of these three actinobacteria in the nickel-contaminated soils significantly ($P<0.05$) enhanced nickel uptake by Bermuda grass from nickel-contaminated soils compared to control treatments which included only nickel without the application of these actinobacteria. The results suggest that plant growth-promoting actinobacteria containing ACC deaminase offer promise as bacterial inoculum for improvement of plant growth, particularly under unfavorable environmental conditions such as heavy metals contamination in soils.

Keywords: ACC deaminase, actinobacteria, Bermuda grass, ethylene, heavy metals, rhizosphere, plant growth-promoting rhizobacteria, plant growth regulators, phytoremediation, hyper-accumulating plants, soil pollution.