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Entitled

INCREASING THE PHYTOREMEDIATION EFFICIENCY OF HEAVY METAL-CONTAMINATED SOILS IN THE UAE USING ENDOPHYTIC ACTINOBACTERIA FOR SUSTAINABLE AGRICULTURE

by

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Date & Venue

10:00 AM

Monday, 15 April 2024

Room 043, F3 Building

Online Link

https://eu.bbcollab.com/guest/0e3465639bd946d396a4e6435d0286e3

Abstract

Pollution caused by heavy metals (HMs) is a major environmental concern worldwide. Human actions, agriculture practices and industrial activities can cause the release of HMs into the environment. Soil contamination with HMs may have negative effects on crops, thus disrupting the food chain and posing risks to human health. Lead (Pb) is a common pollutant found in soils when at high concentrations. Conventional land remediation techniques depending on chemical and mechanical methods are quite expensive and would lead to long-term deterioration of the ecosystems. Phytoremediation can serve as an alternative, eco-friendly approach to restore the lands for agricultural purposes. Hyperaccumulator plants, such as corn (*Zea mays*), have the ability to absorb toxic HMs beyond the normal limits. After certain duration, however, plants may release the stress hormone ethylene (ET) in response to HMs stress. In this study, the aim was to determine the effect of plant growth promoting (PGP) endophytic actinobacteria producing 1-aminocyclopropane1-carboxylate deaminase (ACCD) on plant growth in response to Pb (50 and 100 mM). Endophytic actinobacteria were isolated from the roots of corn plants obtained near Zakher Lake, Al Ain, UAE. According to the *in vitro* tests using different Pb concentrations, two endophytic actinobacteria residing within plant tissues were selected for further investigation. The two endophytic strains were regarded as H2-5 (the non-producing ACCD isolate) and Ax5-1 (the ACCD-producing isolate). Greenhouse experiments were carried out to study the effect of the selected strains on corn plants in response to 50 and 100 mM Pb stress. The obtained results about the growth promotion in corn plants inoculated with Ax5-1 and exposed to any Pb concentration suggest that this ACCD-producing isolate can reduce Pb stress and enhance growth in plants. There were 55% and 36% increase in the length and fresh weight (FW) of the shoot, respectively; in 50 mM Pb exposed corn plants. Upon exposure to 100 mM Pb, plants inoculated with the endophytic Ax5-1 also showed similar pattern of increase in FW in shoot tissues by 52% and root tissues by 34%, compared to control plants not suffering from Pb stress. This suggests that corn plants can hyperaccumulate more Pb in its tissues associated with growth promotion with Ax5-1 inoculation. Under 100 mM Pb stress conditions, plants inoculated with the ACCD-producing endophytic Ax5-1 isolate significantly *($p<0.05$)* accumulated more Pb in root and shoot tissues, resulting in decreased levels of Pb in the treated soil. These findings suggest that PGP endophytic actinobacteria possessing ACCD activity can play a pivotal role in ameliorating the negative effect of Pb stress on plants as an eco-friendly and sustainable agricultural practice.

Keywords: ACC deaminase, corn, endophytic actinoabacteria, ethylene, lead phytoremediation, plant growth promotion.