INOCULATION WITH METAL-MOBILIZING PLANT-GROWTH-PROMOTING RHIZOBACTERIUM Bacillus sp. SC2b AND ITS ROLE IN RHIZOREMEDIATION

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A plant growth-promoting bacterial (PGPB) strain SC2b was isolated from the rhizosphere of Sedum plumbizincicola grown in lead (Pb)/zinc (Zn) mine soils and characterized as Bacillus sp. based on (1) morphological and biochemical characteristics and (2) partial 16S ribosomal DNA sequencing analysis. Strain SC2b exhibited high levels of resistance to cadmium (Cd) (300 mg/L), Zn (730 mg/L), and Pb (1400 mg/L). This strain also showed various plant growth-promoting (PGP) features such as utilization of 1-aminocyclopropane-1-carboxylate, solubilization of phosphate, and production of indole-3-acetic acid and siderophore. The strain mobilized high concentration of heavy metals from soils and exhibited different biosorption capacity toward the tested metal ions. Strain SC2b was further assessed for PGP activity by phytagar assay with a model plant Brassica napus. Inoculation of SC2b increased the biomass and vigor index of B. napus. Considering such potential, a pot experiment was conducted to assess the effects of inoculating the metal-resistant PGPB SC2b on growth and uptake of Cd, Zn and Pb by S. plumbizincicola in metal-contaminated agricultural soils. Inoculation with SC2b elevated the shoot and root biomass and leaf chlorophyll content of S. plumbizincicola. Similarly, plants inoculated with SC2b demonstrated markedly higher Cd and Zn accumulation in the root and shoot system, indicating that SC2b enhanced Cd and Zn uptake by S. plumbizincicola through metal mobilization or plant-microbial mediated changes in chemical or biological soil properties. Data demonstrated that the PGPB Bacillus sp. SC2b might serve as a future biofertilizer and an effective metal mobilizing bioinoculant for rhizoremediation of metal polluted soils.

Rapid industrialization, overuse of agrochemicals, and minimal environmental protection over the past three decades resulted in significant environmental problems worldwide (Li et al., 2014). In particular, heavy metal pollution of soils due to intensified exploitation of mineral resources and emission in smelting process has become a serious concern in many developing countries. Approximately $2 \times 10^7$ ha of arable land in China has been contaminated with heavy metals such as arsenic (As), cadmium (Cd), chromium (Cr), lead (Pb), and