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Variovorax beijingensis sp. nov., a novel plant-associated bacterial species with plant growth-promoting potential isolated from different geographic regions of Beijing, China

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ABSTRACT

Two plant-associated bacterial strains were isolated from Beijing, China. The two strains possessed almost identical 16S rRNA gene sequences. However, REP-PCR fingerprint patterns discriminated that they were not from one clonal origin. The average nucleotide identity (ANI) value and the digital DNA-DNA hybridization (dDDH) value between the two strains were 99.4% and 94.7%, respectively, suggesting that they belonged to the same species. The 16S rRNA gene phylogeny analysis indicated that the two strains belonged to the genus *Variovorax* and were closely related to *V. paradoxus* NBRC 15149^T and *V. boronicumulans* BAM-48^T. Their phylogenetic relationship were confirmed in both phylogenetic trees constructed with house-keeping gene sequences and concatenated core genes of the genome. The ANI and dDDH comparisons among 502^T and the most related type strains showed values below the accepted threshold for species discrimination. The genome sizes of strains 502^T and T529 were 6.76 and 6.69 Mbp, respectively. The strain 502^T had 6,227 predicted genes with DNA G + C content of 67.4 %. The respiratory quinone was ubiquinone-8 and the major polar lipids were phosphatidylethanolamine, phosphatidylglycerol and diphospatidylglycerol. The major fatty acids of strain 502^T were $C_{10:0}$3-OH (26.2%), $C_{16:0}$ (12.9%), $C_{17:0}$ cyclo (14.5%) and summed feature 3 (21.4%). Furthermore, both strains showed the potential of plant growth promotion. Based on these results, the two isolates could be considered to represent a novel species of the genus *Variovorax*, for which the name *Variovorax beijingensis* sp. nov., is proposed, with 502^T (= DSM 106862^T = CGMCC 1.16560^T) as the type strain.

Introduction

The genus *Variovorax* was initially proposed along with the reclassification of *Alcaligenes paradoxus* as *Variovorax paradoxus* [35]. The type species of this genus is *Variovorax paradoxus.* Phylogenetic analyses based on 16S rRNA gene sequences showed that the genus *Variovorax* belongs to the family *Comamonadaceae* of the class *Betaproteobacteria* [35]. At the time of writing, this genus comprised of 12 recognized species (https://www.ezbiocloud.net/taxonomy). Most members of the genus *Variovorax* were isolated from soil [13,17,22,25,26,36], a few species were isolated from other habitats, such as plant [15], sewage [14] and rhizosphere soil [9].

The plant growth-promoting rhizobacteria (PGPR) are considered as important players in plant growth promotion through the production of several growth-related enzymes and hormones. Specifically, the production of 1-aminocyclopropane-1-carboxylate (ACC) deaminase and siderophores are the important characteristics of plant growth-promoting bacteria and endophytes. ACC deaminase cleaves ACC, the immediate precursor of the

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