Potential PGPR properties of cellulolytic, nitrogen fixing, phosphate-solubilizing bacteria in rehabilitated tropical forest soil

ABSTRACT

In the midst of the major soil degradation and erosion faced by tropical ecosystems, rehabilitated forests are being established to avoid the further deterioration of forest lands. In this context, cellulolytic, nitrogen-fixing (N-fixing), phosphate-solubilizing bacteria are very important functional groups in regulating the elemental cycle and plant nutrition, hence replenishing the nutrient content in forest soils. As is the case for other potential plant growth-promoting (PGP) rhizobacteria, these functional bacteria could have cross-functional abilities or beneficial traits that are essential for plants and can improve their growth. This study was conducted to isolate, identify, and characterize selected PGP properties of these three functional groups of bacteria from tropical rehabilitated forest soils at Universiti Putra Malaysia Bintulu Sarawak Campus, Malaysia. The bacteria were isolated based on their colonial growth on respective functional media, identified using both molecular and selected biochemical properties, and were assessed for their functional quantitative activities as well as PGP properties based on seed germination tests and indole-3-acetic acid (IAA) production. Out of the 15 identified bacterial isolates that exhibited beneficial phenotypic traits, a third belong to the genus Burkholderia and a fifth to Stenotrophomonas sp., with both genera consisting of members from two different functional groups. The results of the experiments confirm the multiple PGP traits of some selected bacterial isolates based on their respective high functional activities, root and shoot lengths, and seedling vigor improvements when bacterized on mung bean seeds, as well as significant IAA production. The results of this study suggest that these functional bacterial strains could potentially be included in bio-fertilizer formulations for crop growth on acid soils.

Keyword: Rehabilitated forest; Functional bacteria; Cellulolytic activities; Nitrogen-fixation activities; Phosphate-solubilization activities; IAA production