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Screening of phosphate-solubilizing microorganisms in rhizosphere and rhizoplane of adverse soil-adapting plants in Southern Thailand

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Abstract **Various adverse soils; peat, podzolic sandy, acid sulfate and salted-affected acid sulfate soils were widely distributed throughout Southern Thailand. These soils were infertile and strongly acidic. Phosphorus fertility of these soils was low due to the low content of available phosphorus (0.31-3.70 mg kg^{-1}) especially in podzolic sandy soil. Acid sulfate soil and salt-affected acid sulfate soil contain relatively high level of exchangeable Al (13.3 and 9.87 cmolc kg^{-1}, respectively). However, some native plants; *Melaleuca cajuputi, Melastoma malabathricum, Scleria sumatrensis* and *Oryza sativa* grow well in these adverse soils. Since the adverse soils distributed there are phosphorus-unavailable soils. Hence, base on an idea that phosphate-solubilizing microorganism is a key factor for plant growth, such functional rhizospherous microorganisms were screened using modified Pikovskaya's media containing 5 mg l^{-1} P in different phosphate forms, Al-PO_4, Fe-PO_4 and Na-phytate, and adjusted pH 4.0. The number of microorganisms in the rhizosphere tended to be lower than in the rhizoplane. Twelve isolates showed remarkable growth performance on these solid media. Among these selected, 5 strains were obtained from acid sulfate soil, suggesting acid sulfate soil-adapting plant is a good source of the phosphate-solubilizing microorganism.**

Key Words: adverse soil, low phosphorus soil, phosphate-solubilizing microorganism, rhizoplane and rhizosphere

INTRODUCTION

Various adverse soils, such as peat, sandy podzolic, acid sulfate and salt-affected acid sulfate soils are widely distributed throughout Southern Thailand. All adverse soils are acidic and have low fertility, and therefore, when field crops are cultivated or introduced into these soils and serious nutritional problems often occur. Among soil productivity constrains, phosphorus plays a crucial role in crop productivity because these soils have low phosphorus availability (Osaki et al. 1998; Onthong et al. 1999). However, some plant species, such as *Panicum maximum, Pueraria phaseoloides, Melaleuca cajuputi, Panicum repens* and *Melastoma malabathricum,* all of which can adapt to such problematic soils, grow well without any fertilization (Osaki et al. 1997; Watanabe et al. 1997).

It is well known that a considerable variety of microorganisms are associated with the plant rhizosphere (Rodriguez and Fraga 1999). For example Oishi et al. (1999) found that a population size of bacteria in the root of reed-grass (*Lepiroonia articulate*) grown in acid sulfate soil was the same order as that of canola or wheat cultivated in neutral soil (Hong and Sato, 1994; Germida et al. 1998). This study suggested that the association between microorganism and plant rhizosphere provide the host plant a beneficial effect on plant growth, probably by means of the solubilization of soil-bound inorganic phosphates, particularly in acid sulfate soil. Moreover, in peat soil which contains relatively large amounts of organic phosphates, rhizospherous microorganisms are expected to hydrolyze such organic phosphates, including phytate.

As particular inhabitants in rhizosphere, some microorganisms play a critical role in mediating the availability of soil phosphorus to the host plants. Such functional microorganisms may directly act to phosphate solubilization and mineralization. An extensive range of microorganisms that are able to solubilize various forms of soil-bound phosphorus have been reported (Rodriguez and Fraga, 1999; Whitelaw, 2000), and among them, the most predominant and representative ones are *Bacillus* sp.and *Pseudomonas* sp., soil bacteria, and *Penicillium* sp. and *Aspergillus* sp.saprophytic fungus. On the basis of previous screening assays, it has been