

Study of Root Exudate Organic Acids and Microbial Populations in Palm Oil Seedling Rhizosphere

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ABSTRACT

Mutual interaction between plants and microbes occurred in the rhizosphere is expected to increase productivity of crops or soil fertility for agriculture. Plants secrete root exudates to attract microbes, and then microbes obtain habitat and food supply from plants and can fulfill the nutrient requirements through assisted enzymatic activity. The purposes of this study were to study 1) the types and amounts of root exudate organic acids, 2) microbial population, and 3) the relationship between root exudate organic acids and microbial populations in the rhizosphere of oil palm seedlings. The study was conducted in a greenhouse with planting medium using a sterile quartz sand by two factorials completely randomized design with three replications. Factor 1 was oil palm seedlings age (control / no oil palm seed, 1, 3, 6, 9 and 12 months-old) and factor 2 was the length of the growing season (45, 90, 135 and 180 days) with 72 experimental units. HPLC analysis revealed that four kinds of organic acids were found with the highest concentration were: acetic acid (1.66 ppm), citric acid (0.157 ppm), malic acid (2.061 ppm) and oxalic acid (0.675) ppm. Soil microbials analyzed by the pour plate method with parameters of the total population of bacteria, fungi, Azotobacter, bacteria and phosphate solubilizing fungi were found with the consecutive highest amount: 19.38×10^6 cfu g⁻¹ of soil, 3.28×10^4 cfu g⁻¹ of soil, 12.09×10^5 cfu g⁻¹ of soil, 8.39×10^4 cfu g⁻¹ of soil and 1.15×10^4 cfu g⁻¹ of soil. There is a positive correlation between root exudate organic acids with total microbes, fungi, Azotobacter, PSB and PSF.

Keywords: Microbes, organic acids, root exudates

INTRODUCTION

Utilization and increasing of mutual interaction occurs in the rhizosphere could be expected to increase crop productivity or soil fertility for agriculture. Rhizosphere is a soil part within the direct influence of the root system of plants with a few millimeters thickness from the root surface. The nature of the soil is influenced by root exudates which vary depending on the species, variety, growth stage of crops and soil types.

Plant have the ability to optimize their own growth in poor soils. In general, there are two mechanisms of plants which can increase absorption: morphological and physiological traits. Morphological traits include growth, distribution and root hair formation, while physiological traits include sorption kinetics and nutrient mobilization (Rao et al. 1999). Physiological responses of plant roots to low availability of nutrients is through the roots kinetics

and nutrients mobilization by increasing exudation of organic acids considered as a mechanism to improve nutrient uptake.

Root exudates are substantially the chemical compounds released by root into soil (Walker et al. 2003). Besides acts as mechanical support for plants, extraction of water and nutrients, plant roots also show a special role, including the ability to synthesize, accumulate and secrete a series of chemical compounds (root exudates). However, the process mediated by the roots in the rhizosphere is well unknown, although the process has an important role for the plant. The presence of root exudates in rhizosphere plays role in influencing chemical reactions and microbial activity in the neighborhood. Root exudation in organic acids form and other carbon compounds are not only directly affect the increase of nutrients availability for the plants, but also have an indirect effect through microbial activity because these compounds are an energy source for soil microbes.

The existence of microbes in the soil has an important role, especially in the decomposition of